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ABSTRACT

The rate training manual is one of a series of training handbooks prepared for enlisted personnel of the Navy and Naval Reserve who are studying for advancement in the Aviation Structural Mechanic E (AME) rating. The manual is based on the professional qualifications for the rates AME1 and AMEC. Chapters are organized according to specific job responsibilities: (1) work center supervision and administration, (2) aviation supply, (3) corrosion control, (4) oxygen system support equipment, (5) oxygen system maintenance, (6) pressurization and air-conditioning systems, (7) emergency egress systems, and (8) miscellaneous utility systems. Illustrated throughout, step-by-step instructions and diagrams are provided for each task and item of equipment involved. (Author/MW)

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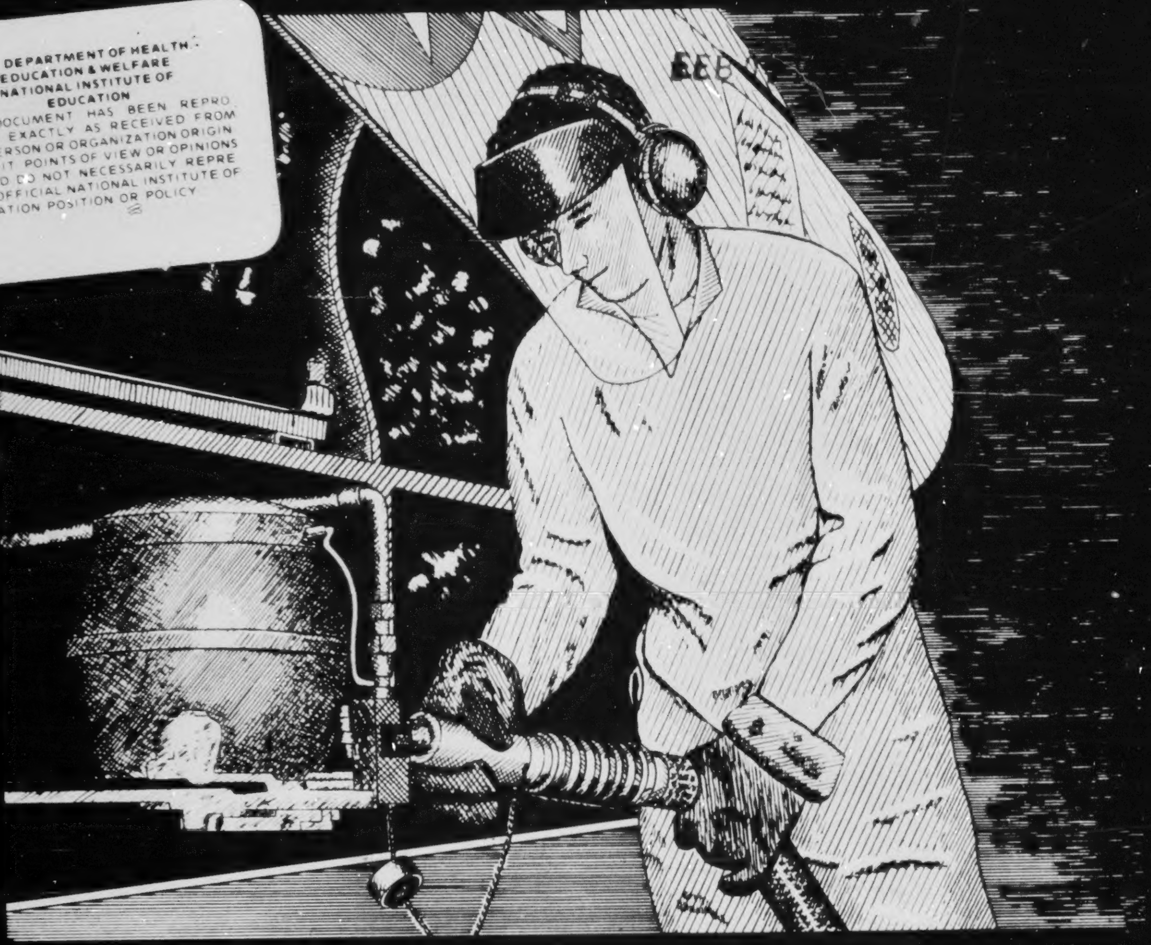

AVIATION

STRUCTURAL MECHANIC E 1 & C

NAVAL EDUCATION AND TRAINING COMMAND

RATE TRAINING MANUAL NAVEDTRA 10312-C

CE003463

PREFACE

This Rate Training Manual is one of a series of training manuals prepared for enlisted personnel of the Navy and Naval Reserve who are studying for advancement in the Aviation Structural Mechanic E (AME) rating. As indicated by the title, the manual is based on the professional qualifications for the rates AME1 and AMEC, as set forth in the Manual of Qualifications for Advancement, NavPers 18068 (Series).

This training manual was prepared by the Navy Training Publications Center, NAS, Memphis, Millington, Tennessee, for the Naval Training Support Command. Technical review of the manuscript was provided by personnel of the AME (A) School, NAS, Memphis, Millington, Tennessee, the Naval Examining Center, Great Lakes, Illinois, and the Naval Aviation Integrated Support Center, Patuxent River, Maryland. Technical assistance was also provided by the Naval Air Systems Command.

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THE UNITED STATES NAVY

GUARDIAN OF OUR COUNTRY

The United States Navy is responsible for maintaining control of the sea and is a ready force on watch at home and overseas, capable of strong action to preserve the peace or of instant offensive action to win in war.

It is upon the maintenance of this control that our country's glorious future depends; the United States Navy exists to make it so.

WE SERVE WITH HONOR

Tradition, valor, and victory are the Navy's heritage from the past. To these may be added dedication, discipline, and vigilance as the watchwords of the present and the future.

At home or on distant stations we serve with pride, confident in the respect of our country, our shipmates, and our families.

Our responsibilities sober us; our adversities strengthen us.

Service to God and Country is our special privilege. We serve with honor.

THE FUTURE OF THE NAVY

The Navy will always employ new weapons, new techniques, and greater power to protect and defend the United States on the sea, under the sea, and in the air.

Now and in the future, control of the sea gives the United States her greatest advantage for the maintenance of peace and for victory in war.

Mobility, surprise, dispersal, and offensive power are the keynotes of the new Navy. The roots of the Navy lie in a strong belief in the future, in continued dedication to our tasks, and in reflection on our heritage from the past.

Never have our opportunities and our responsibilities been greater.

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CHAPTER 1

AVIATION STRUCTURAL MECHANIC E RATING

This Rate Training Manual is designed to aid the AME2 in preparing for advancement to AME1 and the AME1 in preparing for advancement to AMEC. It is based primarily on the professional requirements or qualifications for AME1 and AMEC, as specified in the Manual of Qualifications for Advancement, NavPers 18068 (Series). In preparing for the advancement examination, this manual should be studied in conjunction with Military Requirements for Petty Officer 1 & C, NavPers 10057 (Series).

ENLISTED RATING STRUCTURE

The present enlisted rating structure includes two types of ratings: general rating and service ratings.

GENERAL RATINGS are designed to provide paths of advancement and career development. A general rating identifies a broad occupational field of related duties and functions requiring similar aptitudes and qualifications. General ratings provide the primary means used to identify billet requirements and personnel qualifications. Some general ratings include service ratings; others do not. Both Regular Navy and Naval Reserve personnel may hold general ratings.

Subdivisions of certain general ratings are identified as SERVICE RATINGS. These service ratings identify areas of specialization within the scope of a general rating. Service ratings are established in those general ratings in which specialization is essential for efficient utilization of personnel. Although service ratings can exist at any petty officer level, they are most common at the PO3 and PO2 levels. Both Regular Navy and Naval Reserve personnel may hold service ratings.

AVIATION STRUCTURAL MECHANIC (AM) RATING

The AM rating is divided into three service ratings at paygrades E-4 through E-7. The service ratings are AME (Safety Equipment), AMS (Structures), and AMH (Hydraulics).

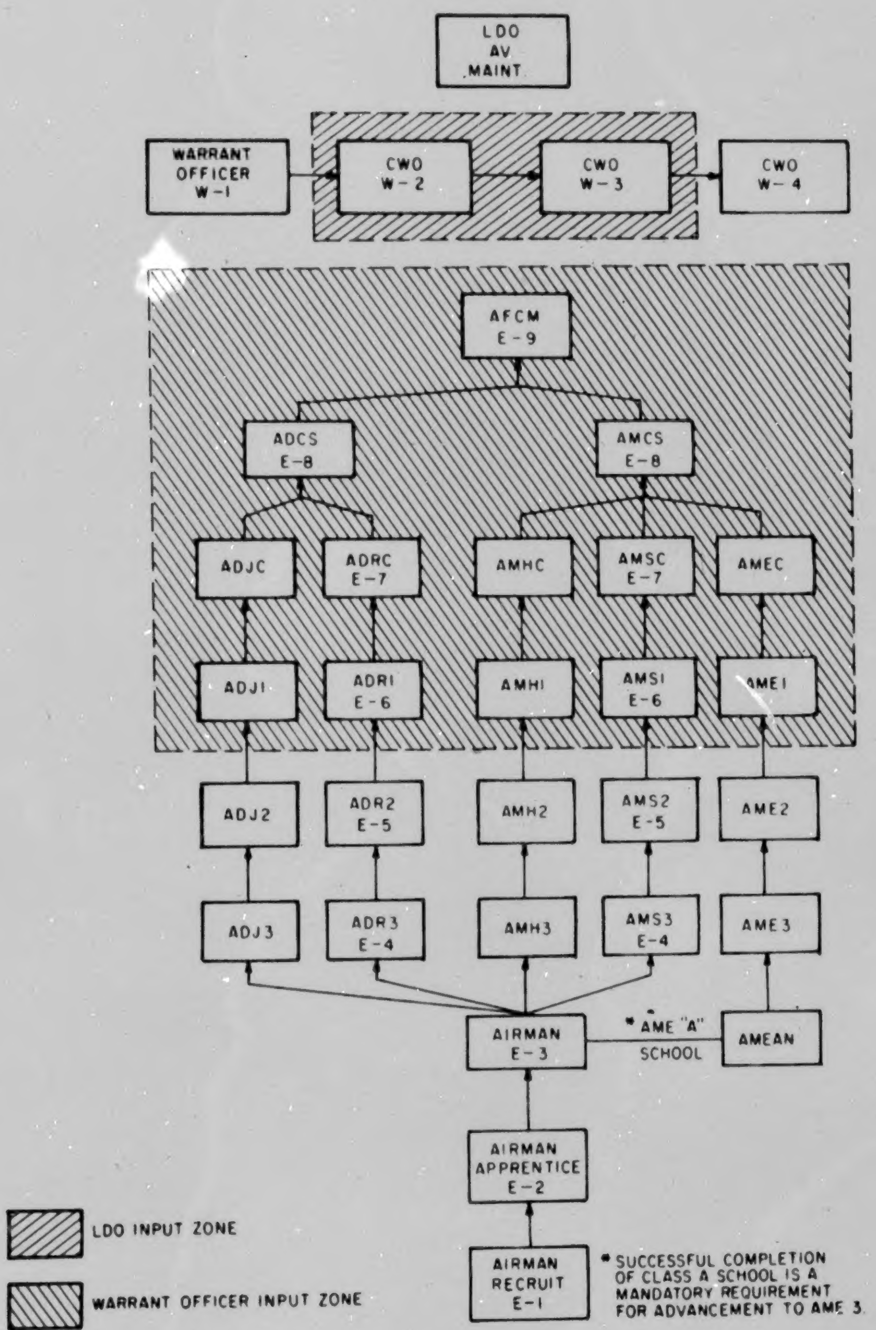
At paygrades E-8 the general rating, AM, applies. Therefore, upon advancement to E-8, paygrade E-7 personnel (AMEC's, AMSC's, AMHC's) are combined to become Senior Chief Aviation Structural Mechanics (AMC's).

At paygrade E-9 the AM rating loses its identity and personnel in the rating advance, along with ADCS', to Master Chief Aircraft Maintenancemen (AFCM's).

Figure 1-1 illustrates all paths of advancement for an Airman Recruit to Master Chief Aircraft Maintenanceman, Warrant Officer (W-4), or to Limited Duty Officer. Shaded areas indicate career stages where qualified enlisted personnel may advance to Warrant Officer (W-1) and selected Warrant Officers may advance to Limited Duty Officer. Personnel in enlisted rates and warrant ranks not in a shaded area may advance only as indicated by the lines.

The Manual of Qualifications for Advancement, NavPers 18068 (Series), states that AME's are responsible for the maintenance of safety belts, shoulder harnesses, inertia reels, emergency egress systems, liferaft ejection systems, oxygen systems, fire extinguishing systems, pressurization and air-conditioning systems, anti-g systems, and other utility systems.

The AME1 must be qualified to supervise and direct aircraft inspections; maintain work center registers and prepare reports; maintain current work center files of directives and other publications; and be able to inventory aircraft. In addition, the AME1 must show his ability to identify and order aircraft parts, tools, and equipment; use schematic diagrams, drawings, and charts while troubleshooting and correcting aircraft discrepancies; and inspect, test, and adjust firing mechanisms in ejection seats, lap


LDO
AV
MAINT
WARRANT OFFICER W-1
CWO W-2
CWO W-3
CWO W-4
AFCM E-9
ADCS E-8
AMCS E-8
ADJC
ADRC E-7
AMHC
AMSC E-7
AMEC
ADJ1
ADR1 E-6
AMH1
AMS1 E-6
AME1
ADJ2
ADR2 E-5
AMH2
AMS2 E-5
AME2
ADJ3
ADR3 E-4
AMH3
AMS3 E-4
AME3
AIRMAN E-3
* AME "A" SCHOOL
AMEAN
AIRMAN APPRENTICE E-2
AIRMAN RECRUIT E-1
LDO INPUT ZONE
WARRANT OFFICER INPUT ZONE
* SUCCESSFUL COMPLETION OF CLASS A SCHOOL IS A MANDATORY REQUIREMENT FOR ADVANCEMENT TO AME 3

AM.1

Figure 1-1.—Paths of advancement.

7

belts, canopies, and other cartridge-actuated devices.

When the AME is working with oxygen systems, he must know the operating principles of liquid and gaseous oxygen shop transfer equipment; be able to analyze oxygen system malfunctions, isolate defective components, and determine corrective action; and test oxygen systems, replace defective components, and know the procedures for testing oxygen for contamination.

In addition to the preceding list, the AMEC must be qualified to analyze reports of discrepancies, and malfunctions and determine corrective action. In addition, he must be able to read and interpret daily and monthly MDR and MHA reports. He also organizes and administers a program of safety instruction applicable to the Aviation Structural Mechanic's equipment and facilities; he interprets and applies Aircraft Changes, Bulletins, and other Technical Directives; maintains quality assurance of work performed; and should be capable of preparing for advanced base or forward area operation.

In addition to the above listed qualifications, the AME1 and AMEC should assist and aid subordinates to prepare and meet the qualifications for advancement in rate.

A wide variety of assignments is available to the AME1 and AMEC. In addition to the various types of maintenance activities to which lower rated personnel are assigned, the AME1 and AMEC are eligible for assignment to instructor duty as well as a number of other desirable shore billets.

Most of these billets are directly associated with training. Some of the more desirable billets to which the AME1 and AMEC may be assigned are described in the following paragraphs.

1. Instructor duty is available to both the AME1 and AMEC at NATTC, NAS Memphis, Millington, Tennessee, in the following schools:

Aviation Familiarization School (Class P).
Mechanical Fundamentals School (Class A).
Aviation Structural Mechanic E School (Class A).
Aviation Structural Mechanic E School (Class B).
Aviation Maintenance Officers School (Class O).

In addition to the above listed instructor billets, the AME1 and AMEC may be assigned to instructor duty with a Naval Air Maintenance Training Detachment (NAMTRADET). NAMTRADET's are located at shore stations throughout the United States. Personnel assigned to this duty are first sent to Naval Air Maintenance Training Group headquarters at NAS Memphis, Millington, Tennessee, for a period of indoctrination and instruction.

Instructor billets are normally filled on a voluntary basis. Detailed information concerning assignment to instructor duty is contained in the Enlisted Transfer Manual, NavPers 15909 (Series).

2. E-7's, E-8's, and E-9's of all ratings are eligible for assignment to duty with the Naval Education and Training Program Development Center (NavEdTraProDevCen), Ellyson, Pensacola, Florida as Technical Writers. NavEdTraProDevCen was recently established by consolidating the following former activities: Naval Examining Center, Great Lakes, Illinois; Navy Training Publications Center, NAS Memphis, Tennessee; Naval Correspondence Course Center, Scotia, New York; and Naval Training Publications Detachment, Washington D. C. As a result of this consolidation Aviation Structural Mechanics at the E-7 and E-8 levels and those former AM's who have advanced to AFCM assigned to NavEdTraProDevCen assist in the preparation and/or revision of Rate Training Manuals, Nonresident Career Courses, and Navywide advancement examinations for the AME, AMH, and AMS ratings. Current allowance calls for three Aviation Structural Mechanics with a normal three-year tour of duty.

There are a number of special programs and projects to which enlisted personnel may be assigned. Some of these involve research, others may involve testing, or evaluation. An example of such an assignment is with the Naval Aviation Integrated Logistic Support Center (NAILSC), NATC, Patuxent River, Maryland. Their mission is to develop recommended personnel requirements for squadrons operating and maintaining the latest types of weapons systems.

For a listing of other special programs and projects, reference should be made to the

Enlisted Transfer Manual. Others are also announced from time to time in BuPers Notices.

Personnel may indicate their desire for assignment to a specific program or project by indicating it in the "Remarks" block of their Rotation Data Card.

As a petty officer, you are already aware of the importance of the AME rating to naval aviation. Pilots and aircrewmen depend upon the AME rating for the efficient operation of much of their airborne safety equipment. As higher and higher aircraft speeds and altitudes are attained, new and improved items of safety equipment are developed. Thus, the AME's job involves more and more responsibilities; and from the lowest level up, he must possess greater technical skills than ever before.

When advanced to AME1 or AMEC, even more responsibilities are to be yours. As a senior petty officer, you must possess more than technical skills. You must assume greater responsibility not only for your own work, but also for the work of others who serve under you. Briefly, the AME1 and AMEC must be a skilled mechanic, supervisor, inspector, and instructor, as well as an accomplished military leader. Senior petty officers are therefore vitally concerned with the Naval Leadership Program.

As a result of the Naval Leadership Program, a considerable amount of material related to naval leadership for the senior petty officer is available. Studying this material will make you aware of your many leadership responsibilities as a senior petty officer and will also be of great help in developing leadership qualities. It will not in itself, however, make you a good leader. Leadership principles can be taught, but a good leader acquires that quality only through hard work and practice.

As you study this material containing leadership traits, keep in mind that probably none of our most successful leaders possessed all of these traits to a maximum degree, but a weakness in some traits was more than compensated for by strength in others. Critical self-evaluation will enable you to realize the traits in which you are strong, and to capitalize on them. At the same time you must constantly strive to improve on the traits in which you are weak.

Your success as a leader will be decided, for the most part, by your achievements in inspiring others to learn and perform. This is best accomplished by personal example.

ADVANCEMENT

By this time, you are probably well aware of the personal advantages of advancement—higher pay, greater prestige, more interesting and challenging work, and the satisfaction of getting ahead in your chosen career. By this time, also, you have probably discovered that one of the most enduring rewards of advancement is the training you acquire in the process of preparing for advancement.

The Navy also profits by your advancement. Highly trained personnel are essential to the functioning of the Navy. By advancement, you increase your value to the Navy in two ways: First, you become more valuable as a person who can supervise, lead, and train others; and second, you become more valuable as a technical specialist and thus make far-reaching contributions to the entire Navy.

Since you are studying for advancement to PO1 or CPO, you are probably already familiar with the requirements and procedures for advancement. However, you may find it helpful to read the following sections. The Navy does not stand still. Things change all the time, and it is possible that some of the requirements have changed since the last time you went up for advancement. Furthermore, you will be responsible for training others for advancement; therefore, you will need to know the requirements in some detail.

HOW TO QUALIFY FOR ADVANCEMENT

To qualify for advancement, a person must:

1. Have a certain amount of time in grade.
2. Complete the required Rate Training Manuals either by demonstrating a knowledge of the material in the manual by passing a locally prepared and administered test or by passing the nonresident Career Course based on the Rate Training Manual.
3. Demonstrate the ability to perform all the PRACTICAL requirements for advancement by completing applicable portions of the Record of Practical Factors, NavEdTra 1414/1.

4. Be recommended by your commanding officer, after the petty officers and officers supervising your work have indicated that they consider you capable of performing the duties of the next higher rate.

5. Demonstrate KNOWLEDGE by passing a written examination on (a) military requirements, and (b) professional qualifications.

Remember that the requirements for advancement can change. Check with your educational services office to be sure that you know the most recent requirements.

When you are training lower rated personnel, it is a good idea to point out that advancement is not automatic. Meeting all the requirements makes a person ELIGIBLE for advancement, but it does not guarantee his advancement. Such factors as the score made on the written examination, length of time in service, performance marks, and quotas for the rating enter into the determination of who will actually be advanced.

HOW TO PREPARE FOR ADVANCEMENT

What must you do to prepare for advancement? Advancement is not an overnight affair. One does not take the advancement examination and wake up in the morning in the next pay grade. There is a path or sequence of events which one must pursue. Certain things must be done or accomplished before one is admitted to partake in the advancement examination. You must study the qualifications for advancement, work on the practical factors, study the required Rate Training Manuals, and study other materials that are required for advancement. To prepare for advancement, you should be familiar with the purpose, use, and interrelationship of the following publications pertaining to the advancement process.

1. Manual of Qualifications for Advancement, NavPers 18068 (Series).
2. Record of Practical Factors, NavEdTra 1414/1.
3. Bibliography for Advancement Study, NavEdTra 10052 (Series).
4. Applicable Rate Training Manuals and their companion nonresident Career Courses.

Collectively, these documents make up an integrated training package tied together by the qualifications. The following paragraphs describe these materials and give some information on how each one is related to the others.

"Quals" Manual

The Manual of Qualifications for Advancement, NavPers 18068 (Series), gives the minimum requirements for advancement to each rate within each rating. This manual is usually called the "Quals" Manual, and the qualifications themselves are often called "quals." The qualifications are of two general types: (1) military requirements, and (2) professional or technical qualifications. Military requirements apply to all ratings rather than to any one rating alone. Professional qualifications are technical or professional requirements that are directly related to the work of each rating.

Both the military requirements and the professional qualifications are divided into subject matter groups. Then, within each subject matter group, they are divided into PRACTICAL FACTORS and KNOWLEDGE FACTORS.

The qualifications for advancement and a bibliography of study materials are available in your educational services office. The "Quals" Manual is changed more frequently than Rate Training Manuals are revised. By the time you are studying this training manual, the "quals" for your rating may have been changed. Never trust any set of "quals" until you have checked the change number against an UP-TO-DATE copy of the "Quals" Manual.

In training others for advancement, emphasize these three points about the "quals":

1. The "quals" are the MINIMUM requirements for advancement. Personnel who study MORE than the required minimum will have a great advantage when they take the written examinations for advancement.

2. Each "qual" has a designated rate level—chief, first class, second class, or third class. You are responsible for meeting all "quals" specified for the rate level to which you are seeking advancement AND all "quals" specified for lower rate levels.

3. The written examinations for advancement will contain questions relating to the practical factors AND to the knowledge factors of BOTH the military requirements and the professional qualifications.

Record of Practical Factors

Before you can take the Navy-wide examination for advancement, there must be an entry in your service record to show that you have qualified in the practical factors of both the military requirements and the professional qualifications. A special form known as the Record of Practical Factors, NavEdTra 1414/1 (plus the abbreviation of the appropriate rating), is used to keep a record of your practical factor qualifications. The form lists all practical factors, both military and professional. As you demonstrate your ability to perform each practical factor, appropriate entries are made in the DATE and INITIALS columns.

As a PO1 or CPO, you will often be required to check the practical factor performance of lower rated personnel and to report the results to your supervising officer.

As changes are made periodically to the "Quals" Manual, new forms of NavEdTra 1414/1 are provided when necessary. Extra space is allowed on the Record of Practical Factors for entering additional practical factors as they are published in changes to the "Quals" Manual. The Record of Practical Factors also provides space for recording demonstrated proficiency in skills which are within the general scope of the rating but which are not identified as minimum qualifications for advancement. Keep this in mind when you are training and supervising other personnel. If a person demonstrates proficiency in some skill which is not listed in the "quals" but which is within the general scope of the rating, report this fact to the supervising officer so that an appropriate entry can be made in the Record of Practical Factors.

When you are transferred, the Record of Practical Factors should be forwarded with your service record to your next duty station. It is a good idea to check and be sure that this form is actually inserted in your service record before you are transferred. If the form is not in your record, you may be required to start all over again and requalify in practical factors that have already been checked off. You should also take some responsibility for helping lower rated personnel keep track of their practical factor records when they are transferred.

A second copy of the Record of Practical Factors should be made available to each man in pay grades E-2 through E-8 for his personal record and guidance.

The importance of NavEdTra 1414/1 cannot be overemphasized. It serves as a record to indicate to the petty officers and officers supervising your work that you have demonstrated proficiency in the performance of the indicated practical factors and is part of the criteria utilized by your commanding officer when he considers recommending you for advancement. In addition, the proficient demonstration of the applicable practical factors listed on this form can aid you in preparing for the examination for advancement. Remember that the knowledge aspects of the practical factors are covered in the examination for advancement. Certain knowledge is required to demonstrate these practical factors and additional knowledge can be acquired during the demonstration. Knowledge factors pertain to that knowledge which is required to perform a certain job. In other words, the knowledge factors required for a certain rating depend upon the jobs (practical factors) that must be performed by personnel of that rating. Therefore, the knowledge required to proficiently demonstrate these practical factors will definitely aid you in preparing for the examination for advancement.

NavTra 10052

Bibliography for Advancement Study, NavEdTra 10052 (Series), is a very important publication for anyone preparing for advancement. This publication/bibliography lists required and recommended Rate Training Manuals and other reference material to be used by personnel working for advancement. NavEdTra 10052 (Series) is revised and issued each year by Naval Training Support Command. Each revised edition is identified by a letter following the NavEdTra number; be SURE you have the most recent edition.

The required and recommended references are listed by rate level in NavEdTra 10052(Series). It is important to remember that you are responsible for all references at lower rate levels, as well as those listed for the rate to which you are seeking advancement.

Rate Training Manuals that are marked with an asterisk (*) in NavEdTra 10052 (Series) are MANDATORY at the indicated rate levels. A mandatory training manual may be completed by (1) passing the appropriate nonresident Career Course that is based on the mandatory training manual; or (2) passing locally prepared tests based on the information given in the mandatory training manual; or (3) in some cases, successfully completing an appropriate Navy school.

When training personnel for advancement, do not overlook the section of NavEdTra 10052 (Series) which lists the required and recommended references relating to the military requirements for advancement. All personnel must complete the mandatory military requirements training manual for the appropriate rate level before they can be eligible to advance. Also, make sure that personnel working for advancement study the references listed as recommended but not mandatory in NavEdTra 10052 (Series). It is important to remember that ALL references listed in NavEdTra 10052 (Series) may be used as source material for the written examinations, at the appropriate levels.

Rate Training Manuals

There are two general types of Rate Training Manuals. Rate Training Manuals (such as this one) are prepared for most enlisted rates and ratings, giving information that is directly related to the professional qualifications for advancement. Subject matter manuals give information that applies to more than one rating.

Rate Training Manuals are revised from time to time to bring them up to date technically. The revision of a Rate Training Manual is identified by a letter following the NavEdTra number. You can tell whether a Rate Training Manual is the latest edition by checking the NavEdTra number (and the letter following the number) in the most recent edition of List of Training Manuals and nonresident Career Courses, NavEdTra 10061 (Series). (NavEdTra 10061 is actually a catalog that lists current training manuals and correspondence courses; you will find this catalog useful in planning your study program.)

Rate Training Manuals are designed for the special purpose of helping naval personnel prepare for advancement. By this time, you have probably developed your own way of studying these manuals. Some of the personnel you train, however, may need guidance in the use of Rate Training Manuals. Although there is no single "best" way to study a training manual, the following suggestions have proved useful for many people:

1. Study the military requirements and the professional qualifications for your rate before you study the training manual, and refer to the "quals" frequently as you study. Remember, you are studying the training manual primarily to meet these "quals."
2. Set up a regular study plan. If possible, schedule your studying for a time of day when you will not have too many interruptions or distractions.
3. Before you begin to study any part of the training manual intensively, get acquainted with the entire manual. Read the preface and the table of contents. Check through the index. Thumb through the manual without any particular plan, looking at the illustrations and reading bits here and there as you see things that interest you.
4. Look at the training manual in more detail, to see how it is organized. Look at the table of contents again. Then, chapter by chapter, read the introduction, the headings, and the subheadings. This will give you a clear picture of the scope and content of the manual.
5. When you have a general idea of what is in the training manual and how it is organized, fill in the details by intensive study. In each study period try to cover a complete unit—it may be a chapter, a section of a chapter, or a subsection. The amount of material you can cover at one time will vary. If you know the subject well, or if the material is easy, you can cover quite a lot at one time. Difficult or unfamiliar material will require more study time.
6. In studying each unit, write down questions as they occur to you. Many people find it

helpful to make a written outline of the unit as they study, or at least to write down the most important ideas.

7. As you study, relate the information in the training manual to the knowledge you already have. When you read about a process, a skill, or a situation, ask yourself some questions. Does this information tie in with past experience? Or is this something new and different? How does this information relate to the qualifications for advancement?

8. When you have finished studying a unit, take time out to see what you have learned. Look back over your notes and questions. Maybe some of your questions have been answered, but perhaps you still have some that are not answered. Without referring to the training manual, write down the main ideas you have learned from studying this unit. Do not just quote the manual. If you cannot give these ideas in your own words, the chances are that you have not really mastered the information.

9. Use nonresident Career Courses whenever you can. The courses are based on Rate Training Manuals or other appropriate texts. As mentioned before, completion of a mandatory Rate Training Manual can be accomplished by passing a nonresident Career Course based on the training manual. You will probably find it helpful to take other nonresident Career Courses, as well as those based on mandatory training manuals. Taking a nonresident Career course helps you to master the information given in the training manual, and also gives you an idea of how much you have learned.

INCREASED RESPONSIBILITIES

When you assumed the duties of a PO3, you began to accept a certain amount of responsibility for the work of others. With each advancement, you accept an increasing responsibility in military matters and in matters relating to the professional work of your rate. When you advance to PO1 or CPO, you will find a noticeable increase in your responsibilities for leadership, supervision, training, working with others, and keeping up with new developments.

As your responsibilities increase, your ability to communicate clearly and effectively must also increase. The simplest and most direct means of communication is a common language. The basic requirement for effective communication is therefore a knowledge of your own language. Use correct language in speaking and in writing. Remember that the basic purpose of all communication is understanding. To lead, supervise, and train others, you must be able to speak and write in such a way that others can understand exactly what you mean.

Leadership and Supervision

As a PO1 or CPO, you will be regarded as a leader and supervisor. Both officers and enlisted personnel will expect you to translate the general orders given by officers into detailed, practical, on-the-job language that can be understood and followed by relatively inexperienced personnel. In dealing with your juniors, it is up to you to see that they perform their jobs correctly. At the same time, you must be able to explain to officers any important problems or needs of enlisted personnel. In all military and professional matters, your responsibilities will extend both upward and downward.

Along with your increased responsibilities, you will also have increased authority. Officers and petty officers have POSITIONAL authority—that is, their authority over others lies in their positions. If your CO is relieved, for example, he no longer has the degree of authority over you that he had while he was your CO, although he still retains the military authority that all seniors have over subordinates. As a PO1, you will have some degree of positional authority; as a CPO, you will have even more. When exercising your authority, remember that it positional—it is the rate you have, rather than the person you are, that gives you this authority.

A Petty Officer conscientiously and proudly exercises his authority to carry out the responsibilities he is given. He takes a personal interest in the success of both sides of the chain of command . . . authority and responsibility. For it is true that the Petty Officer who does not seek out and accept responsibility, loses his authority and then the responsibility he thinks he deserves. He must be sure, by his example and by his instruction, that the Petty Officers under him also accept responsibility. In short, he must be the leader his title—Petty Officer—says he is.

Training

As a PO1 or CPO, you will have regular and continuing responsibilities for training others. Even if you are lucky enough to have a group of subordinates who are all highly skilled and well trained, you will still find that training is necessary. For example, you will always be responsible for training lower rated personnel for advancement. Also, some of your best workers may be transferred; and inexperienced or poorly trained personnel may be assigned to you. A particular job may call for skills that none of your personnel have. These and similar problems require that you be a training specialist—one who can conduct formal and informal training programs to qualify personnel for advancement, and one who can train individuals and groups in the effective execution of assigned tasks.

In using this training manual, study the information from two points of view. First, what do you yourself need to learn from it? And second, how would you go about teaching this information to others?

Training goes on all the time. Every time a person does a particular piece of work, some learning is taking place. As a supervisor and as a training expert, one of your biggest jobs is to see that your personnel learn the RIGHT things about each job so that they will not form bad work habits. An error that is repeated a few times is well on its way to becoming a bad habit. You will have to learn the difference between oversupervising and not supervising enough. No one can do his best work with a supervisor constantly supervising. On the other hand, you cannot turn an entire job over to an inexperienced person and expect him to do it correctly without any help or supervision.

In training lower rated personnel, emphasize the importance of learning and using correct terminology. A command of the technical languages of your occupational field (rating) enables you to receive and convey information accurately and to exchange ideas with others. A person who does not understand the precise meaning of terms used in connection with the work of his rating is definitely at a disadvantage when he tries to read official publications relating to his work. He is also at a great disadvantage when he takes the examinations for advancement. To train others in the correct use of technical terms, you will need to be very careful in your own use of words. Use correct terminology and insist that personnel you are supervising use it too.

You will find the Record of Practical Factors, NavEdTra 1414/1, a useful guide in planning and carrying out training programs. From this record, you tell which practical factors have been checked off and which ones have not yet been done. Use this information to plan a training program that will fit the needs of the personnel you are training.

On-the-job training is usually controlled through daily and weekly work assignments. When you are working on a tight schedule, you will generally want to assign each person to the part of the job that you know he can do best. In the long run, however, you will gain more by assigning personnel to a variety of jobs so that each person can acquire broad experience. By giving people a chance to do carefully supervised work in areas in which they are relatively inexperienced, you will increase the range of skills of each person and thus improve the flexibility of your working group.

Working With Others

As you advance to PO1 or CPO, you will find that many of your plans and decisions affect a large number of people, some of whom are not even in your own occupational field (rating). It becomes increasingly important, therefore, for you to understand the duties and the responsibilities of personnel in other ratings. Every petty officer in the Navy is a technical specialist in his own field. Learn as much as you can about the work of others, and plan your own work so that it will fit into the overall mission of the organization.

Keeping Up With New Developments

Practically everything in the Navy—policies, procedures, publications, equipment, systems—is subject to change and development. As a PO1 or

CPO, you must keep yourself informed about changes and new developments that affect you or your work in any way.

Some changes will be called directly to your attention, but others will be harder to find. Try to develop a special kind of alertness for new information. When you hear about anything new in the Navy, find out whether there is any way in which it might affect the work of your rating. If so, find out more about it.

SOURCES OF INFORMATION

As a PO1 or CPO, you must have an extensive knowledge of the references to consult for accurate, authoritative, up-to-date information on all subjects related to the military and professional requirements for advancement.

Publications mentioned in this chapter are subject to change or revision from time to time—some at regular intervals, others as the need arises. When using any publication that is subject to revision, make sure that you have the latest edition. When using any publication that is kept current by means of changes, be sure you have a copy in which all official changes have been made.

The educational services officer will always have the most up-to-date information and training manuals applicable to your rating.

In addition to training manuals and publications, training films furnish a valuable source of supplementary information. Films that may be helpful are listed in the U.S. Navy Film Catalog, NavAir 10-1-777.

ADVANCEMENT OPPORTUNITIES FOR PETTY OFFICERS

Making chief is not the end of the line as far as advancement is concerned. Proficiency pay, advancement to Senior (E-8) and Master (E-9) Chief, and advancement to Warrant Officer and Commissioned Officer are among the opportunities that are available to qualified petty officers. These special paths of advancement are open to personnel who have demonstrated outstanding professional ability, the highest order of leadership and military responsibility, and unquestionable moral integrity.

PROFICIENCY PAY

The Career Compensation Act of 1949, as amended, provides for the award of proficiency pay to designated enlisted personnel who possess special proficiency in a military skill. Proficiency pay is given in addition to regular pay and allowances and any special or incentive pay to which you are entitled. Certain enlisted personnel in pay grades E-4 through E-9 are eligible for proficiency pay. Proficiency pay is allocated by ratings and NEC's, with most awards being given in the ratings and NEC's which are designated as critical. The eligibility requirements for proficiency pay are subject to change. In general, however, you must be recommended by your commanding officer, have a certain length of time on continuous active duty, and be career designated.

ADVANCEMENT TO SENIOR AND MASTER CHIEF

Chief petty officers may qualify for the advanced grades of Senior and Master Chief. These advanced grades provide for substantial increases in pay, together with increased responsibilities and additional prestige. The requirements for advancement to Senior and Master Chief are subject to change but, in general, include a certain length of time in grade, a certain length of time in the naval service, a recommendation by the commanding officer, and a sufficiently high mark on the Navy-wide examination. The final selection for Senior and Master Chief is made by a regularly convened selection board.

Examination Subjects

Qualifications for advancement to Senior Chief Petty Officer and Master Chief Petty Officer have been developed and published in the Manual of Qualifications for Advancement, NavPers 18068 (Series). They officially establish minimum military and professional qualifications for Senior and Master Chief Petty Officers.

Bibliography for Advancement Study, NavEdTra 10052 (Series), contains a list of study references which may be used to study for both military and professional requirements.

The satisfactory completion of the nonresident career course titled Military Requirements for Senior and Master Chief Petty Officers. NavEdTra 91209, is required of all personnel advancing to E-8 and E-9.

ADVANCEMENT TO WARRANT AND COMMISSIONED OFFICER

The Warrant Officer program provides opportunity for advancement to warrant rank for E-6 and above enlisted personnel. E-6's, to be eligible, must have passed an E-7 rating exam prior to selection.

The LDO program provides a path of advancement from warrant officer to commissioned officer. LDO's are limited, as are warrants, in their duty, to the broad technical fields associated with their former rating.

If interested in becoming a warrant or commissioned officer, ask your educational services officer for the latest requirements that apply to your particular case.

CHAPTER 2

WORK CENTER SUPERVISION AND ADMINISTRATION

As a Chief or First Class Aviation Structural Mechanic E you may be assigned duties as the safety and survival equipment work center supervisor. A work center is a functional area to which maintenance personnel are assigned; therefore, a division, branch, or shop may be referred to as a work center. The term "work center" came into existence with the establishment of the 3-M System.

The responsibility of supervision and administration of a work center is a many-sided and enduring task. Some of the techniques will have been learned through past experience while still others will have to be learned during the actual supervision and administration of the work center or by self-study courses and technical publications. The intent of this chapter is to acquaint the new supervisor with some of the more important aspects of supervision and administration.

SUPERVISOR REQUIREMENTS

The AME in a supervisory position sets in motion the plans, schedules, and policies of his superiors. His primary concern is seeing that the job gets done, rather than performing the work himself.

To accomplish this end, the supervisor must know his men, assign them work within their capabilities, direct their efforts, and assume responsibility for seeing that each job is done correctly.

The supervisor's objectives are to operate with maximum efficiency and safety, to operate with minimum expense and waste, and to operate as much as possible free from interruption and difficulty. These three objectives are amplified in Military Requirements for Petty Officer 1 and C, NavPers 10057 (Series).

It is important that an AM assigned supervisory duties keep in mind the importance of his new assignment to him personally. It affords him the opportunity to gain practical experience for future promotions. His duties cannot be approached in a haphazard manner. To make right decisions, the supervisor must be knowledgeable, possess integrity, and utilize common sense. He should employ the principles of good leadership in carrying out his assignment. The information provided in Principles and Problems of Naval Leadership, NavPers 15924 (Series), will prove invaluable to the new supervisor until he has gained more experience.

KNOWLEDGE

Effective supervision of a work center requires a competent degree of knowledge concerning all areas of aircraft maintenance that could affect the work center. The senior petty officer must keep abreast of new ideas and be aware of the variety of directives and publications that regulate his actions. He must be knowledgeable of the factors that make him a maintenance manager, of programs that affect his work area, of his rating, and the weapon system being supported.

Maintenance Management

Maintenance may be defined as any function related to retaining equipment/material in, or restoring it to, a serviceable condition by servicing, repair, modification, modernization, overhaul, test, inspection, etc. The term maintenance has a general meaning and therefore will rarely be used by itself in manuals, instructions, etc. It will almost always be followed or preceded by another word which conveys a more specific meaning.

Management is also a general term to denote central executive direction and control of a work effort by an individual or group of individuals who are provided appropriate resources and assigned to accomplish a function.

The term maintenance management as it applies to production divisions, branches, and work centers is defined as the process of planning, organizing, staffing, directing, and controlling of an organization's industrial resources necessary in the physical performance of equipment maintenance. The goals of maintenance management are the effective and economical support of all equipment required to achieve the operational objectives of the Secretary of the Navy and the Department of Defense.

Maintenance management as it pertains to the Naval Aviation Maintenance Program and the Maintenance Data Collection Subsystem is based on the principle of management by exception. It means simply that actions or incidents which vary markedly from established standards or norms are singled out as exceptions from the whole for special management attention. For example, if certain models of aircraft or equipment consistently fail to attain established material readiness standards, those models would be singled out for special study and appropriate corrective action. If certain aircraft systems or equipment chronically fail and/or consume abnormal numbers of maintenance manhours or replacement parts, this exception would receive special attention. Work centers which consistently fail to meet production schedules or which consistently require personnel to perform overtime work might also be singled out for special attention. The principle of management by exception is not new and is particularly adaptable to aviation maintenance through the use of modern machine data processing equipment.

Supervisors at all levels concerned with maintenance must consciously and intelligently apply this principle in order to most effectively use their resources in men, money, and materials.

The principles of planning, organizing, staffing, directing, and controlling must be understood and implemented at all levels of command if maintenance is to be accomplished in an orderly manner. The supervisor who coordinates his work center's activities and communicates, both externally and within the activity, provides the catalyst which insures that effective application of these basic principles provide a smooth functioning maintenance organization.

The Naval Aviation Maintenance Program (NAMP), OpNav Instruction 4790.2 (Series), outlines command, administrative, and management relationships and establishes policies for the assignment of aviation maintenance tasks. As defined in this instruction, the work center supervisor is responsible for the following actions:

1. Insuring the accomplishment of all assigned work.
2. Insuring maximum utilization of personnel and facilities.
3. Making recommendations concerning work center repair capabilities and facility requirements.
4. Causing all work to be inspected as required.
5. Initiating of material requirements to support the workload.
6. Screening of all source documents, work requests, and associated paperwork to insure accuracy, completeness, and timeliness of submission.
7. Keeping maintenance control informed of work status.
8. Reviewing of daily manhour (when applicable) and maintenance data reports for accuracy and submission of necessary corrections.
9. Insuring that the maintenance department training program is properly supported within the work center.

The supervisor who endeavors to become thoroughly familiar with the contents of the Naval Aviation Maintenance Program Manual, volumes 1-4, will be better equipped to handle the administrative affairs of the work center. By the time most petty officers reach the E-5 level, they should be totally familiar with the variety of source documents associated with aircraft maintenance. Use of these documents is covered in Military Requirements for Petty Officer 3 & 2, NavPers 10056 (Series). NavPers 10057 (Series), Military Requirements for PO 1 & C, provides coverage on the various man-hour and maintenance data reports as well as other pertinent areas of the NAMP.

Special Programs

The senior AME will by necessity become involved in the variety of special programs that directly or indirectly affect the supervision of his work center. OpNav Instruction 4790.2 (Series) provides amplifying information on selected maintenance programs such as the following:

1. Component repair.
2. Foreign object damage (FOD) prevention program.
3. Corrosion control and preservation.
4. LOX surveillance.
5. NavAirSysCom calibration program.
6. Zero defects.

Separate chapters provide in-depth information concerning Quality Assurance, Unsatisfactory Material/Condition (UR) Reporting System, Planned Maintenance System, etc.

Rating

The supervisor who has had varied experience in all aspects of his rating is a definite asset to any command. A complete knowledge on one's rating is not easily achieved. All too often, personnel put in the required training courses and rely on the information retained from the Rate Training Manual to get them by. Study of the latest editions of these manuals and the additional reference material listed in NavEdTra 10052 will assist in the never-ending attempt to stay current. When advancement in rating qualifications change, the alert petty officer notes these changes and strives to correct any knowledge deficiencies that might exist. Curiosity regarding activity correspondence, changes and bulletins, changes to maintenance publications and other maintenance directives, as well as changes to other sources of information which affect the supervisor's work center and/or rating can result in increased ability and confidence.

Weapon System Being Supported

The number of aircraft accidents, ground accidents, and incidents involving maintenance errors has increased steadily for the past several fiscal years. As the number of errors increased, the most often repeated errors continued to be the same from year to year. Some of the errors cause little or no damage and consequently have not been appropriately advertised. Many maintenance errors can be attributed to failure of the supervisor to properly perform his duties.

A knowledge of the weapon system being supported is a must requirement. The training lectures prepared for use in training personnel within the work center should be a valuable source of information regarding the weapon system. Study of the appropriate volumes of the Maintenance Instructions Manual that affect the AME and completion of courses on the weapons system provided by the NAMTRADET's will better equip the supervisor to make decisions regarding maintenance of the systems. Use of the MIM when performing maintenance applies to both the worker and the supervisor. The complexity of many of today's aircraft systems requires that step-by-step procedures be followed for accomplishing removal, installation, repair, operational testing, etc. It is impossible to commit these step-by-step procedures to memory. Personnel who are unfamiliar with a task that is assigned should readily admit their lack of proper training rather than attempt the task with questionable results. It is not uncommon for a supervisor to find that a subordinate has greater knowledge of a particular system than the supervisor. If he has been to one of the NAMTRADET's courses on that particular system and/or has considerable experience, it is entirely conceivable. However, the supervisor must make it a habit to verify any doubtful information and correct any knowledge deficiencies on his part, or he may lose some of the respect necessary to maintain control of his men. This is not to imply that he should be distrustful of his men. Sometimes subordinates feel that information passed on to them by others is correct without verifying it in the MIM. In summary, it is better to admit when you do not know something and then follow through by doing something about it immediately.

SUPERVISION AND LEADERSHIP

The experienced petty officer will soon learn that supervision and leadership are very closely related. The supervisor's role requires that he be a leader, a man of common sense, and a man who earns the respect of others. Many decisions are difficult to make. To be effective in his decision making, the supervisor assembles pertinent facts, policies, and procedures; develops a course of action and evaluates possible alternatives; selects the best course of action; and initiates the required action. When necessary, he consults his own superior prior to taking action. Every supervisor must face problems squarely and make timely and sound decisions. The supervisor who dodges his responsibilities will soon find his control of subordinates slipping away, discipline deteriorating, dissatisfaction with his supervision increasing, and effectiveness of the organization suffering.

The supervisor who establishes and maintains a spirit of cooperation within his work center and in the everyday dealings with other work centers and maintenance control will find his job is much easier. Aircraft readiness is the common purpose of the maintenance organization, and all ratings should share a common interest in achieving that purpose. A willingness by each individual to submerge his personal interests in favor of getting the job done is a necessary prerequisite to cooperation. If the supervisor's requests are reasonable, made well in advance (when possible), were understood, and provided all the necessary information, his requests will generally induce cooperative action. If cooperation is lacking, check the facts to find out why. If subordinates are at fault, they can be told directly and in a firm manner, taking into consideration the basic principles of good leadership.

The supervisor's duties involve planning, direction, and control. Careful planning is an essential ingredient to effective supervision and minimizes other types of supervisory efforts when carefully executed. Time and effort invested in the process of careful planning is rarely wasted. It can result in job simplification and increased efficiency.

The effective supervisor initiates the planning process by identifying each specific job to be done by his men. With a routine clearly established, he can spend his time on the exceptions that may arise. He knows the capacities, interests, weaknesses, and potentials of his men. Knowing each man's level of technical skill, motivation, ambitions, and personality characteristics will enable the supervisor to (1) assign the right man to the right job, (2) identify the training needed by each man to do a better job, and (3) establish the standard at which each man can be expected to perform.

Once action has been initiated, the supervisor provides direction. This function of supervision is like that of a "foreman." He sees that work is started and knows what is going on at all times. This does not mean that he must always be physically present while the job is being done. Subordinates should be trained to assume responsibility for the job in the absence of the supervisor so that no man is indispensable, including the supervisor. The supervisor should, however, be available when his men are working, and they should know how to contact him. The supervisor should always be present when his men are assigned new tasks, when they have trouble getting a job done, or when other circumstances dictate the necessity for his presence. He must be careful not to oversupervise lest he destroy the initiative of his workers and subordinate supervisors. He receives suggestions and reactions from his subordinates and acts as necessary on them, giving credit when and where it is due. Recognition of each man as an individual is required.

Control of a job refers to the function of checking to see that the job is done as planned—a comparing of performance with plans. Deviations may reflect poor planning. However, procedures should exist whereby changes in plans that could result in improved performance can be implemented to minimize repetition of faulty performance.

The supervisor will be challenged to allocate sufficient time to be expended on planning, direction, and control. A spirit of firmness, fairness, cooperation, decisiveness, harmony, and mutual respect while seeing that the job is done will rarely go unrewarded.

Communications

The area of communications as related to supervision and leadership is singled out here because of its importance. Almost without exception, problem areas regardless of their nature can be attributed to the lack of proper communications. Men like to be kept informed about all the things that affect them. Keeping them informed will improve their morale and generally make them more responsive to the needs of the command. The supervisor can improve morale by keeping his men as well informed as possible concerning need-to-know and nice-to-know information that could affect them, as long as it is not classified.

Communications is a two-way process. The supervisor must be able to convey his ideas, orders, etc., and pass on information, either orally or in writing, in such a manner that it will be clearly understood. He must also be willing to listen to and try to understand the ideas of others. Subjectivity (that is, looking at things only from a personal viewpoiint, because of your position, rating, pay grade, or any other reason) will hinder communications. Bias and limited knowledge can limit a supervisor's ability to be objective, and by recognizing this fact he can listen more objectively.

Ridicule, sarcasm, vulgarity, etc., have no place in good communications. The supervisor who must get loud and resort to such language to get his point across or the job done needs to realize how adversely such action affects his own feelings of importance and respect. When it becomes necessary to orally reprimand a subordinate, do it in private, keeping in mind that he is an individual and as a petty officer he must have the respect of the men under him. If a supervisor reprimands a man in public, both lose respect and are less effective in getting the job done.

Professionalism

It is the responsibility of all senior petty officers to instill a spirit of professionalism in their subordinates. Aircraft maintenance is a reasonably complicated profession that leaves little room for error. The maintenance man who gives it less than his undivided attention presents a potential hazard. Of primary importance are the ethical attitudes and considerations involved in performing each maintenance task, the unspoken but carefully adhered to codes governing each man's actions.

The responsible petty officer sets the example he wishes others to follow, doing the right thing in carrying out each assignment, including (and especially so) when no one is watching. Undiluted professionalism means that there is no room for ethical lapses or occasional breaches of integrity. The worker who even once shortcuts established procedures, does not follow maintenance manual instructions, sacrifices quality for speed, or performs any other action which could produce a negative judgment towards him lacks the professional integrity demanded in aviation maintenance. The supervisor who condones such action is equally guilty of a less than professional attitude and the results that such actions could cause.

There is no substitute for thorough knowledge of your aircraft, your job, and the procedures associated therewith. Correct maintenance procedures and thorough quality assurance will almost always produce professional results. Aviation safety demands pure, undiluted professionalism from all personnel involved in maintenance.

WORK SIMPLIFICATION

Work simplification is a common sense, systematic method of identifying and analyzing work problems, developing solutions, and installing improvements. In order to achieve maximum efficiency each supervisor must do his part to improve the work situation and achieve maximum manpower utilization. This implies that the greatest possible use of all resources available be made in order to help accomplish an activity's mission. Work simplification is a tool which can be utilized effectively in the accomplishment of this goal. Work simplification might be considered as human ingenuity applied to the work situation. It is the organized use of common sense and creative thinking in the solution of work problems.

If all men had believed that there could be no better way of doing things, we might still be throwing rocks at game for our food and traveling from place to place on foot. Progress in these fields was not made in a single step but in a series of improvements. These changes occurred slowly over the centuries, growing out of a multitude of small improvements.

The supervisor who lives day to day, satisfied that what he did yesterday is good enough for tomorrow, will, in most cases, leave his job no better from having held it. He leaves nothing significant for other personnel to follow him in his job, and he becomes lost in the shuffle of men who are content with merely living and dying.

The majority of improvements in our world did not come by accident; rather, they came as a result of man's ingenuity, growing out of his sense of imperfection and his constant search for improvement. When an improvement is made, no matter how small, it marks its discoverer as a person of imagination with a real and active interest in his work.

The supervisor who believes in and practices work simplification procedures can look with pride upon his contributions or those of people who work with him. This means that the supervisor should never cease to search for improvement and must encourage his workers to try to improve jobs over which he has control.

The supervisor should always watch for areas where work can be simplified. Work simplification pays immediate dividends by increasing both production quality and quantity. It allows the supervisor to meet work schedules more easily and reduces waste by producing with less effort, increases savings in time and manhours, and thus reduces cost of operation. Work methods improvement aids in establishing standard procedures. These standard procedures aid in training both old and new workers, since most workers are easier to train, and learning is much easier if standard practices are used.

An example of work simplification that is widely used in maintenance activities is a reports tickler file. The tickler file contains information on each report concerning the kind of report required, form or format to be used, due date, address of the office or command to which it is sent, etc. Although the governing directive should be consulted when preparing a report, a properly used reports tickler file simplifies and assists in the preparation and timely submission of required reports.

Work simplification should be considered when arranging the shop equipment (Intermediate maintenance) in the work center. Equipment should be located so that ample room is available to accommodate its use. When possible, equipment should be arranged in a logical manner so that jobs requiring the utilization of several items of equipment can be used in a manner similar to that found in assembly line operations. In a like manner, visual information display boards and/or status boards utilized to control maintenance should be located where they can be easily viewed and kept current without disrupting other personnel.

It is true that with good leadership personnel can be encouraged to work to the limit of their physical endurance but unless their efforts are used wisely, the most critical resource—manpower—is being wasted. In the final analysis, it is not how hard personnel work but how much quality work is accomplished that matters. Therefore, to help achieve maximum results with minimum expenditure of human effort, the supervisor should always strive to use established work simplification techniques.

Work simplification permits continuous evaluation by analyzing existing methods and procedures with a view toward improving them. There is always a better way of performing a task by using streamlined methods, improved tools, better working conditions, or shorter procedures. However, these better methods are not always apparent. Work simplification should be directed at all work situations where physical effort is expended.

Techniques

There are many techniques for improving work methods. For the most part, these techniques are adaptable to any work center or production control as well as the whole activity. Five of the principal techniques which have been successfully applied to work operations are discussed briefly in the following paragraphs. All of these techniques require the construction, completion, and use of lists, charts, flow diagrams, etc., in order to study and analyze specific areas.

WORK DISTRIBUTION ANALYSIS.–Work distribution analysis is a technique used to analyze objectively the division of work in an organization. In order to obtain the most effective distribution of work, it is necessary for the supervisor to have an overall view of the organization and its operations. The supervisor must clearly understand the work that is being done and be able to see the relationship between the overall operation and the individual work units as well as the contribution that each person makes to the work of the whole organization.

Distribution of work is an important factor in efficient use of manpower. Time and effort are saved if related duties are performed by the same person. Thoughtful matching of assignments and qualifications is important so that personnel are not struggling with work that is too hard for them or wasting their time on tasks that might be performed by a less skilled person. Another consideration is distribution of workload to avoid inequalities, since these result in bottlenecks and other inefficiencies.

Work distribution analysis requires that Task List be completed for each person whose work is being studied. This list contains, in simple statements, tasks the worker performs regularly and the average number of hours spent on each task per week. Next, a Function List is prepared which lists each function performed by the work center. Each task reported on the Task List must be related to a specific function. A Work Distribution Chart is prepared from the data collected on the Task List and Function List. This chart presents the work performed in the existing organization under current operating conditions. The chart is then studied and analyzed to find answers to questions such as the following:

1. What functions take the most time?
2. Is there misdirected effort?
3. Are skills being used properly?
4. Are personnel doing too many unrelated tasks?
5. Are tasks spread too thinly?
6. Is work distributed evenly?

A careful study and analysis of the work distribution chart should assist in achieving the following results:

1. Elimination of unnecessary tasks.
2. Reduction of time spent on relatively unimportant functions.
3. Elimination of duplication and overlapping of work.
4. Better balance of workloads.
5. Combination of related tasks.
6. Realistic estimate of personnel needs.
7. Better utilization of skills.
8. Reallocation of misassigned personnel.

WORK COUNT ANALYSIS.–Work count analysis supplements the work distribution analysis and is a technique for determining the volume of work in terms of measurable units. Information obtained by counting or measuring the work provides a basis for improving methods and procedures, adjusting work assignments, evaluating performance, and eliminating bottlenecks. Such information is useful in assigning and scheduling work to insure that the workload is equitably distributed among all personnel.

Items of work counted should be definite and comparable. Items counted should also be representative of work usually performed. Only those should be counted that clarify methods employed. Counting may take place where the work comes into production control, where a decision is made or action is taken, where a process is completed, or where long storage occurs.

Work count information can be used to accomplish the following:

1. Establish how long it takes to do a given piece of work.
2. Indicate whether the volume of a certain piece of work is sufficient to warrant specialization.
3. Show whether work is distributed evenly among workers.
4. Point out bottlenecks where work piles up.
5. Indicate whether the work center is adequately manned, overmanned, or undermanned.
6. Stimulate interest of personnel by providing comparisons of one person's work with that of another or with his own record during a different counting period.

FLOW PROCESS ANALYSIS.–Flow process analysis is a technique for analyzing flow and sequence of operations. The purpose of this analysis is to reduce time and distances in a process by eliminating, combining, and changing the sequence of steps in the flow of work.

The principal tool of this technique is the construction of a flow process chart which provides a clear and detailed picture of the flow of work. Recording each step in a procedure helps to identify duplication of effort, backtracking, and other obstacles to the smooth, efficient flow of work.

MOTION ANALYSIS.–Motion analysis is a technique for making maximum use of physical motions. It is a method of studying the motions of individuals in performing their various tasks.

Work distribution and flow process analyses are directed toward improving the division and flow of work. Motion analysis deals with how an individual performs his tasks. It seeks to learn whether the workers are doing their work with minimum fatigue, loss of time, and waste of effort. Improvements are effected by rearrangement of materials and work area and by proper use of equipment.

The simplest way of gathering data for motion analysis is for the supervisor to watch his personnel at work and note useless motions. Motion analysis should result in the elimination of wasteful motions and consequent loss of work time, reduction of fatigue by lessening the amount of physical effort required to complete a task, and increase the efficiency of personnel.

LAYOUT ANALYSIS.–Layout analysis is a procedure designed to lead to better utilization of space, personnel, and equipment. A study of the layout of a working area can provide useful information for improving the work of individuals, distribution of the workload, and flow of work from one person to another. Its purpose is to determine what space is needed for the operations to be performed and how the available space may be used most effectively. Besides shortening and simplifying motions, it should produce working conditions that are as comfortable and personally satisfactory to the workers as possible consistent with efficient and economical operation.

The layout chart is the principal tool of this type of analysis. This chart consists of a floor plan of the work space, showing doors, windows, electrical outlets, etc. All features that restrict usable space should be included. Items of equipment (test bench, hose burst machine, bending equipment, etc.) should be added and the anticipated flow of work indicated.

The following principles should be kept in mind when studying a work center layout chart:

1. Equipment getting the most use should be located in the most accessible areas.
2. Layout should provide for safe use of equipment.
3. Arrangement of equipment and facilities should allow for effective supervision.
4. Arrangement of equipment should accommodate the necessary flow of personnel utilizing the work area.
5. Maintenance publications should be conveniently accessible to those who use them.
6. Working space allocations should be consistent with working conditions.

INSTALLATION OF IMPROVEMENTS.–Briefly speaking, work simplification means improving methods of doing work or finding a better way. Improved methods usually involve eliminating unnecessary parts of the job, combining and rearranging other parts of the job, and simplifying the necessary parts of the job. By improving methods personnel are able to do better work, with less effort, in less time, without hurrying, with greater safety, and with lower cost. The pattern for achieving the benefits of work simplification is as follows:

1. Select the job to be improved.
2. Break down the job in detail.
3. Question the job and each detail of the job.
4. Develop the new method.
5. Apply and install the new method.

The fact that changes are recommended as a result of a work simplification study does not always mean that these changes will or can be made immediately. There are several reasons why a change that many regard as an improvement may be slow in being adopted.

Most any change will draw objections from a certain number of persons. There are two general types of reasons for these objections. First, many people regard a recommended change as a criticism of the way they have been doing their work and therefore resent it. Most of this type of objection can be avoided if those who will be affected by the change can participate in some degree in the analysis so that the whole enterprise becomes a group activity. If this is not possible, at least a clear explanation should be made regarding reason for the change. Emphasis should be on future advantages rather than criticism of old methods. Secondly, most people have a natural dislike to changing established work habits. If advantages of the new method are clearly explained, this resistance lessens considerably.

Before making any changes it is well to consider carefully all likely effects, for sometimes unforeseen effects may cancel out the beneficial aspects of the change. It is important, for instance, when new equipment or facilities are contemplated, to be sure that advantages of the new installations will outweigh cost. Indirect effects of change upon other equipment or conditions should also be considered.

Effects upon interorganization relationships should also be taken into account. If work procedures are speeded up in one phase of an operation only to create a bottleneck in another, there will be little or no improvement.

PLANNING WORK CENTER ARRANGEMENT

The average Chief or First Class Aviation Structural Mechanic E may never have the opportunity of planning the layout of a work center in a new facility. In almost every case, the new supervisor will take charge of an already functioning division or else, when his squadron or unit moves to a new base, he and his crew will usually be assigned to spaces already basically equipped. In either case, a reevaluation of the work center's layout is indicated. The reevaluation of the layout should include finding out from the applicable allowance lists if the equipment allowances have been changed in any way. There is no use relocating equipments which involve rewiring or plumbing work if improved replacement models are authorized and available.

PURPOSE OF THE WORK CENTER

The work centers have been established to meet the needs and demands of their specific maintenance tasks involved within the activity to insure and aid in carrying out the overall mission of the activity.

In the case of the AME, the maintenance of seat belts, shoulder harnesses, inertia reels, oxygen cylinders, liquid oxygen converters, regulators, lines, connections and fittings, pressurization and air conditioning systems, and ejection seats and canopy mechanisms are some of the specific tasks involved in their work center.

A basic consideration in planning a work center layout is its purpose. When more than one space is available, the supervisor must decide which space would be better suited or advantageous to his work center's work. Thus, the general function of the work center must be considered in the allocation of spaces and equipment. This decision should be based on factors of safety, economy, functional compatibility, and convenience.

ARRANGEMENT

Following the determination of which work center is to occupy which space or area within a space comes the arrangement of furniture and equipment.

The arrangement of the work center furnishing should be made on the basis of utility rather than appearance. Moving an item of equipment into an out-of-the-way corner may greatly improve the appearance of the work center but at the same time reduce the efficiency of personnel using the equipment and may possibly create a safety hazard. A good rule to follow is to locate equipment where it can be safely used by the greatest number of people with a minimum of effort in the least amount of time.

Work tables and benches should be positioned with respect to fixed equipment so that the equipment most often used is most quickly and easily reached. Electrical and compressed air outlets should be readily available to the workbenches. Needless delays are caused by having to rig unnecessarily long connections from poorly located outlets.

Near workbenches where specific and intricate maintenance functions are performed, consideration should be given to installing special lighting such as explosion-proof, vapor-proof, or interference-free type lighting. Under certain conditions, special lighting may also include floodlights for outside work areas and in hangars when improved lighting is required.

Utilization of paint in various colors to emphasize portions of intricate machinery for safety and reflective purposes is known as dynamic painting. Painting in this category should not be utilized for normal building maintenance.

A system of stowing tools must be devised. An intelligent system cannot be set up without first determining from allowance lists what tools will be required for satisfactory operation of the work center. The place for all tools should be marked or otherwise specified, and everything not being used should be kept in that place.

The layout should make provisions for a bulletin board upon which may be posted safety posters, maintenance posters, instructions and notices, plans-of-the-day, and such other information as is appropriate from time to time. The bulletin board should be located in a prominent place in the work center, preferably near the entrance where everyone assigned will have to pass at some time or another during the day. Material on the bulletin board should be changed frequently, expired notices promptly removed, the current plan-of-the-day posted early, and other posters and material rotated periodically. If the same material is presented in the same format every day, it will not be long before the men begin to ignore the bulletin board and purposes for having it are defeated. New arrangements are noticed and interest is stimulated with variety.

When aviation Organizational level maintenance activities are moved aboard ship, their working conditions and accommodations are drastically affected. The ingenuity of the supervisor will be required to produce a workable arrangement within very limited spaces. Stowage racks for toolboxes and other work center equipment should be located to accommodate their frequency of use. Some equipment used at less frequent intervals may have to be stowed in voids. An inventory listing of such items, showing their specific location, will be necessary. Security of material stowed in voids, toolboxes, and other equipment will require more attention than when ashore. Gear not properly stowed and afforded appropriate security has a habit of disappearing, and during rough sea states, can be hazardous to personnel and/or other equipment.

Much of the work done aboard ship will have to be done under less than ideal conditions. Confined spaces, reduced lighting during nighttime flight operations, hazardous conditions on the flight and hangar decks, problems associated with respotting of aircraft to accommodate maintenance, and a variety of conditions peculiar to ship operations will require modification of procedures used ashore. The supervisor should insure that spaces are utilized to their fullest extent.

Since most Organizational level maintenance is "on aircraft" type maintenance, the limited space of the work center should present only a minor problem concerning the stowage of gear and some personnel congestion during periods when personnel are awaiting work. Consideration of the factors previously discussed under "Work Simplification," and further discussed in NavPers 18359 (Series), could result in a smoother transition from shore to shipboard facilities and vice versa.

PROCURING AND CUSTODY OF MATERIAL

The work center supervisor is responsible for ordering aircraft maintenance spare parts and material, tools, and other equipment necessary for the accomplishment of assigned maintenance tasks. Necessarily related to this responsibility are requirements for controlling the use of consumable materials, maintaining and accounting for tools and material held on a custody signature basis, and, when required, the preparation and submission of evaluation reports.

AIRCRAFT PARTS

Aircraft parts are generally ordered for two reasons, the first being replacement for parts which are removed from service on a scheduled basis. These are usually parts which by their failure may cause disastrous consequences. The other general need for aircraft parts results from the failure, damage, or unsatisfactory operation of an aircraft component. As can be seen, parts in the former category may be ordered in advance so they can be on hand when required, but the latter category may not, as their usage is generally unforeseen. In either event, the ordering procedure is the same.

NOTE: Prior to ordering a replacement for a failed part, the supervisor should always consider his responsibility and capability to effect the repair of the old part. If this capability exists (and is permissible) at his level and the repair is accomplished, it will prevent the expenditure of a great amount of time, trouble, and money required to process such material through higher levels of maintenance.

In a more or less predictable length of time consistent with the priority, the part will be delivered to the shop. Prior to opening the package or breaking the preservation in any manner, the Federal Stock Number and any other identifying data on the package should be double checked against the shop order file to insure that they match. Upon depackaging, another check similar to the foregoing should be made to positively identify the part.

If either inspection reveals any inconsistencies of identification data, it may be that the supply office has substituted an interchangeable item. If so, the substitute item should be checked in the Illustrated Parts Breakdown, Section B Allowance List, or the Interchangeability List for ASO and NavAir Cognizance Repairable Assemblies. Interchangeability is discussed in greater detail in chapter 3. If possible, an actual comparison with the old part should be made prior to installation as a further check for suitability.

TOOLS

Ordering of tools is accomplished in much the same manner as ordering of aircraft spare parts. The need for a tool should develop during a periodic tool inventory in order to eliminate a work delay which might develop if a required tool was first discovered missing or damaged during the progress of a job.

Unlike aircraft parts, which should not be stocked in the shops, the Section G Allowance Lists provide for each activity performing Organizational maintenance to have on hand a certain quantity of tools. The applicable allowance lists should be cross-checked with a current tool inventory and any deficiencies made up as soon as possible. In some cases, it may be determined that some tools on the allowance lists are not needed or that the allowed quantity exceeds actual requirements. In such cases, those tools should not be ordered just to have them collect dust on the toolroom shelves. In addition, excess tools serve to complicate the periodic inventories.

Special tools peculiar to a specific weapon system are listed on the activity's Individual Material Readiness Listing (IMRL), discussed in chapter 3 of this manual.

GROUND SUPPORT EQUIPMENT

Items of ground support equipment (GSE) used for servicing and maintaining aeronautical equipment consists of equipment furnished as organizational property and equipment furnished as organizational property and equipment furnished on subcustody from the supporting activity. The Individual Material Readiness Listing (IMRL) discussed in chapter 3 of this manual provides an authorized allowance listing for GSE which may be procured or obtained on subcustody by the supported activity.

Work centers charged with the custody of GSE must insure that proper care is exercised in its daily maintenance, upkeep, and operation. Daily Maintenance Requirements Cards are available for use in maintaining most larger items of support equipment. Items on subcustody from the supporting activity are normally recalled to the supporting AIMD for periodic maintenance inspections.

The supporting activity licenses qualified operators and provides GSE training, in addition to that which may be given as part of the work center's training syllabus. All operators of ground support equipment must be qualified and licensed. The license should be carried at all times when operating GSE.

Status code A ground support equipment is that equipment in the possession of an Organizational or Intermediate maintenance activity and being used in support of assigned missions. Reporting custodians are accountable for each item of GSE in status code A and must report data on its utilization (hours/cycles/starts). Prepunched/preprinted GSE cards are available for utilization reporting. Utilization is reported on the last day of each reporting period.

GSE on subcustody to squadrons or other activities remains the responsibility of the reporting custodian. Personnel designated as being responsible for GSE, within the activity having subcustody, must compile utilization on an appropriate GSE card and forward it to the reporting custodian on the last day of the reporting period. Reporting procedures are provided in detail in volume III of the Naval Aviation Maintenance Program, OpNav Instruction 4790.2 (Series).

INVENTORY AND RECORDS

When the work center is first set up and the initial allowance of tools and equipment is drawn, inventory cards should be made up on each item. These cards should include the name of the item, quantity, manufacturer, model, stock number, date of acquisition, cost, and dates and nature of repairs and replacement parts.

Some items should be kept in the work center toolroom or special cabinet; others placed in individual toolboxes and issued to the workers. A toolbox inventory record should be prepared in duplicate with the original filed in the work center files and the duplicate copy placed in the toolbox, preferably in an oil and grease resistant envelope.

While each toolbox should be adequately stocked, it should not contain tools in excess of actual requirements. Maintenance personnel must utilize some method of tool accountability following each maintenance action to prevent tools being left adrift. Tools should be etched or marked in some other manner that will identify them to a specific work center and toolbox. This acts as a deterent to leaving tools adrift and provides the additional benefit of cutting down on the amount of tool pilferage.

A monthly inventory should be conducted beginning with the toolboxes and ending with the toolroom count. The periodic inventory should be more than just an item count. Since each item is sighted, it provides an opportunity to ascertain if the tools in actual use are being maintained in good repair. If they show evidence of damage or improper use, appropriate corrective action should be taken. The men should be encouraged to make good use of delay time by tool maintenance and equipment servicing.

COST CONSCIOUSNESS

The Navy Cost Reduction Program, NavSo P 2486, strives to create an attitude of total cost consciousness and to encourage the development and implementation of cost reducing actions. Maintenance supervisors as well as their subordinates can play a definite role in reducing costs. Areas where costs can be reduced should be identified and action taken through the chain of command. Recognition to the individual responsible for any cost reduction actions will serve to stimulate the cost reduction program.

Personnel involved in procurement of materials and equipment and those charged with custody of such items should realize that the overall costs for defense materials are tremendous. Costs of weapons systems, associated test equipment/support equipment, and spare parts necessary to support the weapon system during its expected service life have increased steadily to the point where improved management is necessary. Attention must be given to such areas as personnel error, waste of materials and resources, utilization of personnel, accident prevention, etc.

Improved work habits, elimination of unnecessary maintenance tasks, improvements to test equipment, consolidation of functions, greater use of resources, and increased capability for repair of specific items at the lowest level of maintenance are but a few areas that could be evaluated as a means of reducing costs at the working level. Supervisors should be alert to ways of bringing about such improvements and should encourage and assist their personnel in submitting factual beneficial suggestions for consideration and subsequent dissemination.

Materials belonging to the Navy are not procured for the personal use of the individual, yet thousands of dollars are lost annually due to poor control of material resources. Proper security of pilferable items will materially reduce costs. Ordering only that material which is actually needed rather than that which "might" be needed is another area that generally could receive attention. The ways of reducing costs are limited only by the supervisor's imagination and ingenuity. Waste, whether it is of manpower, money, or material, costs the taxpayer and therefore affects almost everyone.

EVALUATION REPORTS

The maintenance of today's high-performance aircraft requires more and more special tools, shop equipment, and ground-handling equipment. Most of this special equipment is designed and manufactured by private contractors. As a result, frequent requests are made by the manufacturer for field activities to evaluate this equipment before final approval is given on a procurement contract or changes are made to the appropriate allowance list. This procedure is approved and encouraged, but a standard procedure for conducting performance evaluations is necessary.

According to current instructions, the manufacturer's request must be approved by the type commander and cognizant COMFAIR before it can be accepted by a field activity for evaluation.

Upon approval, the designated activity should conduct a thorough evaluation of the tools or equipment provided by the manufacturer. NOTE: Failure to do so could result in the purchase of faulty and/or inadequate tools or equipment, thereby causing injury to personnel and/or damage to aircraft and other equipment.

After completion, the activity conducting the evaluation provides the manufacturer, via the COMFAIR and type commander, with a report of the evaluation findings, citing any defects or recommendations for improvement. The report should include the manufacturers' name, name of the product, model number, size, and/or capacity of the product evaluated, and the specific function for which the product may have been used.

TECHNICAL DATA

Technical data for guiding naval personnel in training, operations, maintenance, calibration, repair, storage, and shipment of weapons systems and related components within the Naval Establishment is available in a variety of forms. Technical data is a general term applied to this variety of recorded information which is used to define a design and to produce, support, maintain, or operate items of defense material.

The NavAirSysCom furnishes aircraft maintenance activities with technical information and instructions necessary for the operation and maintenance of weapons systems and related equipment. Technical information and instructions are disseminated in the form of manuals and letter type material. To permit attainment of a satisfactory state of readiness, these publications are published and distributed in time to assure availability to users. By proper use of these publications, all aircraft and other aeronautic equipment can be operated and maintained efficiently and uniformly throughout the Navy.

When a new aircraft, weapons system, engine, accessory, or other item of equipment is accepted by the Navy, manuals necessary to insure its proper operation and upkeep are prepared and issued to all activities using and/or maintaining the equipment. Supplemental information and other directive type publications that must be issued from time to time are issued in the form of letter material. Both manual and letter publications may, on occasion, be properly referred to as directives. Broadly speaking, any communication which initiates or governs action, conduct, or procedure is a directive.

The primary purpose of technical publications is to aid maintenance personnel in accomplishing their work. They are written for and communicate information and direction to maintenance personnel in their own specific technical language. Technical publications are prepared by the prime airframe and powerplant manufacturers, by the manufacturers of specific equipments, and by the NavAirSysCom or its field activities, in accordance with specifications issued by the NavAirSysCom. They set forth current authoritative information concerned with material upkeep, check, test, repair, and operation in a manner to provide for optimum product performance. It is extremely important that all personnel responsible for the maintenance and operation of naval aircraft and associated equipment be thoroughly familiar with and use the publications provided in the daily execution of their maintenance tasks. The time has long since passed when maintenance personnel could properly perform their work without written technical aid or, at the most, after a thumbing through or a one-time reading of the related technical publication. Modern technology is a dynamic, constantly changing thing and requires continuous reference to and the use of the approved and provided ways and means of keeping technically current.

From the foregoing it can be readily seen that maintenance activities require large quantities of technical data for the proper operation and maintenance of aeronautic equipment. The technical library operated by the activity's quality assurance division provides a central point for the procurement and proper dissemination of this technical data. It is the senior petty officer's responsibility to insure that this technical data is utilized in the accomplishment of all maintenance efforts. In this regard, his awareness of technical data and his ability to procure, maintain, and utilize such data will have a direct bearing on his value to the command and the manner in which he performs his duties whether as a crewmember, crew leader, or work center supervisor.

TECHNICAL DIRECTIVE SYSTEM

The Technical Directive (TD), System has been established for control and issue of all technical directives. This system standardizes the method of issuance for such directives and is the authorized means for directing the accomplishment and recording of modifications and one-time inspections to equipment procured by and for the NavAirSysCom. The TD system is an important element in the programs designed to maintain equipment in a configuration which provides the optimum conditions of safety, operational, and material readiness. This system encompasses two types of Technical Directives differentiated by their method of dissemination. These two types are Formal (letter type) and Interim (message type). In general terms, they are both considered as letter type technical directives. These directives contain instructions or information of a technical nature which cannot be satisfactorily disseminated by revisions or changes to technical manuals. This information (instructions) is disseminated in the form of Changes, or in the case of special circumstances, by Interim Changes or Bulletins.

A formal TD is a document issued as a Change, or an Amendment or Revision thereto, and promulgated by letter. Formal technical directives are used to direct the accomplishment and recording of modifications to weapons, weapons systems, support equipment, trainers, and related equipment and are comprised of changes and amendments and/or revisions thereto.

An interim TD is a document issued as a Bulletin or a Change, or as an Amendment or Revision thereto, and promulgated by message to insure expeditious dissemination. The interim TD is reserved for those instances requiring expeditious correction of an operational or safety condition which embodies risks calculated to be intolerable within the lead time of a formal directive or maintenance publication change. Interim Changes are superseded by a formal change directive which will have the same number as the interim directive. Interim Bulletin directives are not superseded by formal bulletins as was previously the case. The NavSup 2002, Section VIII, Part D, will still have many formal bulletins listed until they are eventually phased out.

A Change is a document containing instructions and information which directs the accomplishment and recording of a material change, a repositioning, a modification, or an alteration in the characteristics of the equipment to which it applies. A Change is issued to direct that parts be added, removed, or changed from the existing configuration or that parts or material be altered, relocated, or repositioned.

A change may be issued in parts to accomplish distinct parts of a total directed action or to accomplish action on different configurations of affected equipment. A Change may also be issued for Record Purposes. A Record Purpose Change is a TD issued to provide documentation of a modification which has been completely incorporated by the contractor or in-house activity in all accepted equipment and which does not require retrofit or the modification of repairables in the Navy's possession.

An Amendment is a document comprised of information which clarifies, corrects, adds to, deletes from, makes minor changes in requirements to, or cancels an existing technical directive. It is only a supplement to the existing directive and not a complete directive in itself. A maximum of three Amendments may be applied to a TD, each remaining in effect until rescinded or superseded by a Revision. A requirement for further amendment action necessitates the issuance of a Revision.

A Revision is a completely new edition of an existing directive. It supersedes the original directive or revision and all existing amendments.

A Bulletin is an interim document comprised of instructions and information which directs an initial inspection to determine whether a given condition exists. It specifies what action is to be taken if a given condition is found or not found.

Interim bulletin directives are self-rescinding with rescission dates of 30 June or 31 December, whichever is appropriate for the case at hand. Rescission is the process by which TD's are removed from active files after all requirements have been incorporated. Final rescission action is directed in the TD Index, NavSup Publication 2002, Section VIII, Part D. All activities maintaining active technical libraries should maintain the TD's on file until they are deleted from the TD Index.

Cancellation of a technical directive is the process whereby the TD is removed from the active files when it is determined that a previously issued TD is not to be incorporated. Cancellation is directed by the issuance of an Amendment to the TD. The cancellation explicitly states the required configuration of each article initially specified for modification; for example, whether installed modifications are to remain installed or are to be removed, etc.

The title subject of a Change or Bulletin will be one of the following as appropriate:

Airframe
Powerplant
Avionics
Aviation Armament
Support Equipment
Propeller
Photographic
Airborne Weapon
Aircrew System
Accessory
Target Control System
Meteorological Equipment

Those of primary concern to the AME will generally fall under the basic title of either Airframe, Air Crew System, Accessory, or Support Equipment.

The "Airframe" title is utilized when the action required affects the structure or the installation of any equipment in an aircraft, trainer, drone, or target aircraft.

"Air Crew System" is assigned when the action required affects survival and rescue equipment, egress systems and associated components, and any other equipment utilized, worn, or carried by flight personnel.

When the action required affects aircraft or engine systems such as environmental heating or cooling, pressurization, pneumatic, oxygen, fuel, etc., the "Accessories" title will be assigned.

The "Support Equipment" title is utilized when the action required affects any type of ground support equipment such as test sets, jacks, servicing equipment, transportation dollies, work stands, wheel chocks, etc.

Airframe and Powerplant TD's are further subdivided into specific type/model breakouts while other basic title TD's such as Air Crew System TD's are not.

EXAMPLES:

A-5 Airframe Change No. 63
J-79 Powerplant Change No. 27
Air Crew System Change No. 289
A-4 Interim Airframe Change No. 261
A-5 Interim Airframe Bulletin No. 111

If the technical directive involves safety of flight the word "SAFETY" will appear immediately following the title and number.

Technical directives are numbered by two different methods. Some are numbered consecutively from the beginning of the calendar year with the last two digits indicating the year of issue. Thus, a Change or Bulletin designated 47-54 would be the 47th Change or Bulletin of that type issued in 1954. This type of numbering system is no longer being used for identifying new directives. However, those which have been numbered in this manner and are still in effect are cataloged under this system.

The present numbering system is a consecutive numerical application regardless of the year of issue. For example, F-4 Airframe Change 204 would be the 204th Airframe Change that is applicable to the F-4 aircraft. This numbering system has been in effect for some time and most technical directives are cataloged under this system.

The numbers assigned to Changes and Bulletins are provided by the Technical Directives Control Center, which is located at the Naval Air Technical Services Facility (NATSF), Philadelphia. Changes or Bulletins that have been amended will have their basic number followed by the words "Amendment 1," "Amendment 2," etc. A revised directive will have the basic directive number followed with the words "Rev. A," "Rev. B," etc., as appropriate to denote the first, second, etc., revision to that basic directive.

The Changes and Bulletins are automatically distributed to all concerned activities. All TD's are issued by NAVAIR or NAVAIRTECHSERFAC except in cases where the time delay in obtaining approval is unacceptable. In such cases the controlling custodians are authorized to issue interim TD's to preclude unacceptable risks to personnel or equipment. The Changes or Bulletins are generally based on Contractor Service Bulletins, other letters of recommendation, or proposed modifications from field service activities.

Directive Categories

Technical directives are assigned a "category" in accordance with the importance and urgency of accomplishing the work involved. A category of Immediate, Urgent, Routine or Record Purpose is assigned each technical directive.

The category Immediate Action is assigned to directives which are issued to correct safety conditions, the uncorrected existence of which would probably result in fatal or serious injury to personnel, extensive damage, or destruction of property. These directives are identified by a border of red X's broken at the top center of the page by the words IMMEDIATE ACTION.

The category Urgent Action is assigned to directives which are used to correct safety conditions which, if uncorrected, could result in personnel injury or property damage. These directives are identified by the words URGENT ACTION at the top of the first page and a border of red diagonals around the cover page.

Routine Action directives are those concerned with equipment or procedural deficiencies of a material–mechanical, operational, or tactical in nature–the uncorrected existence of which could constitute a hazard. They are identified by the words ROUTINE ACTION printed at the top of the cover page.

The category Record Purpose is used when a modification has been completely incorporated by the contractor or in-house activity in all accepted equipment and when retrofit is not required of repairables in the Navy's possession. They are identified by the words RECORD PURPOSE printed in black capital letters at the top center of the first page.

The contents of technical directives and revisions thereto are presented in a standard format and written to conform with aeronautical requirements in a regular paragraph sequence. Listed below are the paragraphs in their required order, together with an explanation of their contents.

1. Heading. The heading consists of the TD category and number, authorizing activity, cognizant codes, issue date, rescission date and security requirements. A distriution statement, which is actually a part of the heading information, is included on the last page of the directive.
2. Subject. This is a short topical statement, usually beginning with a noun to indicate the major component or system affected and ending with a brief statement of the action required.
3. References. All previous correspondence and publications relating to the directive are listed under this heading.
4. Enclosures. All enclosures which are appended are identified and listed.
5. Documentation Affected. This section lists all documents, such as manuals, existing technical directives, drawings, tapes, maintenance requirements cards, etc., which are affected by this directive.
6. Purpose of Directive. Each TD includes a concise explanation of its purpose with a sum-

marization of the conditions which necessitated the action, such as potential hazards, failures, accidents, etc. If the TD is a revision, the reason for the original TD and the necessity for publishing the revision are both specified.

7. Application. This paragraph establishes the identity of all items affected. If the action required by the TD is dependent upon prior, concurrent, or subsequent incorporation of other TD's, a dependency statement is listed prior to other application data.

8. Compliance. This paragraph contains information indicating the time limit for performance of the work, the level of maintenance required to incorporate or accomplish the TD, and in some cases an incorporation schedule.

9. Manhours Required. This paragraph specifies the number of personnel and manhours by skill/specialty/rating and the total manhours required. This information is determined from experience or trial modifications whenever possible, otherwise estimates are given. Where more than one kit is included in the application, manhours are indicated for each kit. When an amendment is issued which affects manhours, only those manhours required to incorporate the amendments are reflected. Revisions reflect total manhours and also indicate the number of manhours required to incorporate the additional requirements of the revision for cases where the basic TD and existing amendments may have been previously incorporated.

10. Supply Data. The supply data section specifies the required kits, parts, materials, and special tools and/or equipment necessary to accomplish the TD. This data will include information relative to kit or kits required per aircraft, modification of spares in stock, disposition of removed parts, and the size, weight, and contents of each kit.

11. Reidentification. This paragraph specifies the requirements for marking or reidentifying the equipment or components which are modified by the incorporation of the TD.

12. Detailed Instructions. This section contains both written instructions and illustrations as necessary for the accomplishment of the TD.

13. Weight and Balance. If the TD affects weight and balance to a significant degree, a statement reflecting the effect will be provided in the format used in the original weight and balance manual for that equipment. In some cases the effect of weight and balance will be listed separately for each significant part.

14. Records Affected. This paragraph contains instructions specifying the action to be taken on all records affected by accomplishment of the TD.

15. Interim Support. If support is required to maintain the new configuration pending establishment of complete Navy support, such support is identified and described in this section. Data includes logistics elements, activity furnishing interim support, and the inclusive dates of interim support.

16. Signature. All TD's are signed by the Commanding Officer, NAVAIRTECHSERFAC, or his designated representative.

17. Prepared by. Each directive includes the name of the preparing organization and code.

18. Verified by. Each directive includes the name of the verifying organization and code.

Normally, the shop supervisor does not have to concern himself with the ordering of the change kits required for certain modifications. Standard aircraft maintenance organization procedures provide for Maintenance Control and Material Control to order such kits that are required through the use of the Technical Directives Compliance Form. Utilization of this form is covered in Military Requirements for Petty Officer 3 & 2.

DIRECTIVES ISSUANCE SYSTEM

Instructions and notices are the two main types of directives provided for in the Directives Issuance System which was designed for the purpose of providing a uniform plan of issuing and maintaining directives. Directives may establish policy, organization, methods, or procedures. They may require action to be taken or contain information affecting operations or administration. All Naval Air Systems Command level (and above) originated directives are distributed by the Navy Department Administrations Office, with certain exceptions. Each level of command below Naval Air Systems Command level has an administration office responsible for distributing that level of command directives to its units or addresses below them.

Instructions are those directives containing authority or information having continuing reference value, or requiring continuing action. An Instruction remains in effect until superseded or otherwise canceled by the originator or higher authority.

Notices are directives of a one-time or brief nature, which have a self-canceling provision, and which have the same force and effect as an Instruction. Usually, a Notice will remain in effect for less than 6 months, but is not permitted to remain in effect for longer than 1 year. Any requirement for continuing action contained in a Notice, such as the submission of a report, use of a form, or following a specified procedure, is considered to be canceled when the Notice is canceled, unless the requirement is incorporated into another suitable document.

Instructions and Notices are identified by originator and subject classification. There are 13 major subject classification groups. These major series groups are further subdivided by the use of the last three digits in the major series. The 13 major series groups consist of the following:

1000 Series. Military Personnel.

2000 Series. Communications.

3000 Series. Operations and Readiness.

4000 Series. Logistics.

5000 Series. General Administration and Management.

6000 Series. Medicine and Surgery.

7000 Series. Financial Management.

8000 Series. Ordnance Material.

9000 Series. Ships Design and Ships Material.

10000 Series. General Material.

11000 Series. Facilities and Activities Ashore.

12000 Series. Civilian Personnel.

13000 Series. Aeronautical and Astronautical Material.

These major subject groups are subdivided into primary, secondary, and sometimes tertiary breakdowns. Primary subjects are designated by the last 3 digits (the hundred group) of the code number, secondary subjects by the last 2 digits, and tertiary breakdown by the final digit. For example:

5000 General Administration and Management.

5200 Management Programs and Techniques.

5210 Office Methods and Paperwork.

5215 Issuance Systems.

Some of the smaller subject groups are not subdivided below the primary breakdown. Other larger subject groups are divided into many secondary and tertiary subjects, the extent depending upon the scope and complexity of the major subject.

The first Instruction issued on any of the subject group code numbers will be XXXX.1. For example, the first Instruction issued by NavAirSysCom on directive issuance is 5215.1. Subsequent Instructions issued on the same subject would be numbered in consecutive order; i.e. 5215.2, 5215.3, etc. When there is substantial change in an Instruction, it is rewritten, reissued, and carries the date of revision. Each revision is assigned the same subject classification number as the superseded Instruction, and is further identified by a suffix capital letter; the first revision being A, the second B, etc.—5215.2A, for example.

When changes to instructions are not extensive, they are issued as page replacements or pen changes or a combination of both. Additional pages are also issued as a change. These changes are issued in the form of change transmittals. A change transmittal describes the nature of the change. It is prepared in directive format and is identified by the same number as the instruction which it changes plus the assigned change number. For example, the first change transmittal applicable to OpNav Instruction 5442.2B would be identified as follows: OPNAVINST 5442.2B CH-1.

The AME supervisor will normally be more concerned with records concerning the 4000, 5000, and the 13000 series of the 13 major subject groups. These series are further expanded as follows:

4000 Series—Logistics. This series covers subjects relating to the logistical support of the Navy and Marine Corps, including procurement, supply control, property redistribution and disposal, travel and transportation, maintenance, construction and conversion; production and mobilization planning, and foreign military assistance.

5000 Series—General Administration and Management. This series includes subjects relating to the administration, organization, and management of the Department of the Navy, including general personnel matters, security, external relations, law and legal matters, office services, and publication and printing matters.

13000 Series–Aeronautical and Astronautical Material. This series includes subjects relating to aeronautical and astronautical material such as parts, accessories, instruments, special devices, armament, aerological equipment, weapons systems, types of aircraft, and astronautic vehicles.

NOTE: Notices are not assigned consecutive numbers because of their one-time nature or brief duration. There may be several Notices bearing the same number, differentiated by date of promulgation and subject title.

Each command issues a 5215 directive semiannually which lists all directives by subject, subject number, revisions issued in the last 6 months, and those in effect.

Directives are filed by subject classification number, originator, and consecutive number.

The degree of security classification is indicated alphabetically on each confidential or secret directive, by prefixing the specified letter to the subject number; that is, "C" for confidential and "S" for secret. (Top secret material is excluded from issuance in the directives system.)

NOTE: In the past the procedure to indicate the degree of security classification was to prefix the subject number with zeros. One zero for confidential and two for secret. This prefix is no longer being assigned to new material; however, it remains in effect for those existing directives until superseded.

The issuance of unnecessary directives has been the subject of official concern on more than one occasion. Perhaps this is best expressed by the following quote from OpNav Notice 5216 of 11 September 1963 (Reduction of Administrative Correspondence in the Operating Forces), which was directed to all ships and stations:

"To the maximum practicable extent, avoid issuing repetitive Instructions. If the Navy Directives Manual is complied with, there can be no possible need for all of the duplication now existing. Directives should be complete enough so that no further repetitive issuance is necessary in the chain of command. There is evidence that many Instructions and Notices issued are not being complied with because there are too many for the individual units to keep corrected."

Before local directives are issued, the need for such Instructions and Notices should be established beyond doubt. A system to insure timely revision or cancellation must be installed and maintained conscientiously. An Instruction which is not required or one which is out of date is at best a nuisance, and at worst a serious obstacle.

TECHNICAL MANUAL PROGRAM

The NavAir Technical Manual Program was established as the only official medium for disseminating technical information pertaining to the operation, installation, maintenance, and inspection of Navy aeronautical weapons systems, subsystems, and related support equipment.

Technical manuals are issued by the authority of the Chief of Naval Operations and released under the authority of the Commander, Naval Air Systems Command. Manuals and data pertaining to naval aviation are distributed through the Naval Air Technical Services Facility.

Technical manuals play an important role in achieving and maintaining system and equipment effectiveness and readiness. By proper utilization of technical manuals, systems and equipment can be operated and maintained uniformly throughout the Navy.

The variety of manual publications available to the AME are necessary to understand operational theory, troubleshoot and service the systems, and maintain the systems and associated components. Use of the manuals on a continuing basis; that is, their use in performing each maintenance task, is mandatory. Past experience indicates that constant attention by supervisory personnel is necessary to insure repetitive manual usage. Personnel assigned to perform the same task repeatedly can, if allowed, easily slip into the pattern of relying on memory rather than consult the specific manual that applies to performing the task. Needless to say, this is a dangerous, less than professional, and prohibited practice. Senior personnel must set the example by utilizing the manuals themselves and insure that their subordinates do likewise.

Not every task or common maintenance procedure must or will be covered in detail in technical manuals. Application of common sense and good judgment regarding basic technical knowledge, complexity of tasks, and safety considerations are part of the governing criteria in determining the need for a manual or the inclusion of new material, changes, revisions, etc., to existing manuals.

If an error or collection of terminology in a maintenance manual provides a distorted meaning of instructive information or prevents adequate performance of functions required for mission accomplishment, it should be reported as a manual deficiency, utilizing an Unsatisfactory Material/Condition Report (UR). Minor discrepancies of a nontechnical nature are not considered deficiencies and will not be reported unless they change the meaning of instructive information and procedures. Criteria to be considered prior to reporting a deficiency, the category to be assigned the report based on the urgency of the action required, and other specific submission procedures are provided in the Technical Manual, Naval Air Systems Command, Technical Manual Program, NavAir 00-25-100, and OpNav Instruction 4790.2. Failure to report known deficiencies could have serious consequences. It is each supervisor's responsibility to submit timely recommendation for change, addition, or deletion of information as necessary.

Chapter 2 of AME 3 & 2 NavTra 10309-C provides a description of the contents and purpose of various types of manual publications of concern to AME personnel, and knowledge of that material is presumed.

Updating Technical Manuals

The methods for assuring that technical manuals are maintained current to the extent necessary to maintain their validity or remove them from active status include issuing of Changes, Rapid Action Changes, Revisions, Supplements, and Appendices or by recission or replacement of a complete manual.

Changes, Rapid Action Changes (RAC), and Revisions are used to update a manual by replacing, adding, or removing changed pages in the manual.

Supplements are issued when it becomes necessary to augment or change data in basic manuals that is not adaptable to the inclusion of individual change pages or when the use of change pages is not suitable or practicable. Changes and Revisions are normally issued instead of Supplements except in emergency circumstances where Supplements must be utilized because of the critical time element.

Supplements issued for the Naval Aeronautic Publications Index provide an example of a situation where it would be impractical to issue Change Pages vice a Supplement. Supplements are issued as separate manuals and may be cumulative or noncumulative. Cumulative Supplements include all the data contained in Supplements previously issued and supersede the preceding Supplement. The Supplement will be sectioned in a manner appropriate to the manual which it supplements and will be identified by the same manual title and number as the basic manual with the word "Supplement" printed at the top of the title page.

Appendices are issued when it becomes necessary to include information in a manual that is not part of the normal sequence outlined in the contents, such as charts, tables, listing of codes, etc. Such material becomes an integral part of the affected manual.

CHANGES.–Changes are issued when only parts of the existing manual are affected. The change pages replace the correspondingly numbered pages. When the Change is a Formal Change, all replaced pages must be removed and discarded. If the Change contains additional data that cannot be included on the replacement page, additional pages are issued. The page numbers issued to additional pages are the preceding page number plus capital letter suffixes in consecutive order or page numbers continuing in numerical sequence, depending on the circumstances.

A Formal Change alters a portion of a manual already in existence and does not constitute a large enough change to warrant issuance of a Revision. The Formal Change replaces, adds, or deletes pages and/or illustrations and the change pages are prepared to be collated into the manual without disrupting the manual format and sequence. The Formal Change is issued to include new models of equipment or add new procedures and to change existing equipment and procedures which do not create an emergency situation.

Manuals consisting of eight pages or less and those which do not include a title page are replaced by a complete revision of the manual in lieu of change page insertions.

RAPID ACTION CHANGES. Rapid Action Changes (RAC's) are manual changes used to expedite the dissemination and incorporation of essential and urgent operation and maintenance information to technical manuals. Utilizing an interim RAC, information impacting safety of flight, hazards to personnel, grounding of aircraft, mission capability, equipment damage, or maintenance capability will be disseminated via naval message and incorporated into the affected manuals immediately.

A Manual Change Page followup will then be required within 15 days of release of the message. Information of a less urgent nature is promulgated by printed Rapid Action Change Pages. This type RAC is subjected to printing within 30 days after problem resolution and is limited to 12 pages or less.

The RAC system has phased out the previous Interim Manual Change. However, it does not affect the procedures for issuing and incorporating Formal Changes. The RAC merely supplements the Formal Change procedures to provide for rapid issue of urgently required data that was previously held up by the procedures involved in complying with the normal change system.

CHANGE ENTRY CERTIFICATION. It is not feasible for every work center to have a copy of every publication that is used by the particular work center; however, they should have the publications most often used such as Maintenance Instruction Manuals, Illustrated Parts Breakdowns, and certain General Manuals. All publications held by the work center should be checked out (issued) from the activity's technical library, which functions as a part of the quality assurance division.

The technical library utilizes technical publications location cards to account for each publication held in the library as well as those issued to the various work centers. By using this system, the technical library can maintain reasonable control of all work center publications and applicable Revisions, Changes, etc., can be procured and issued as necessary to keep all publications current.

When Changes for a particular publication are received, technical library personnel check the location card and issue the Change to all holders of that publication, utilizing a Change Entry Certification Form. When the Change has been incorporated, the certification portion of the form is completed by the holder and returned to the technical library. This provides a record that the Change has been incorporated in the applicable publication. Most technical library systems dictate a maximum time allowed for incorporation of the Change to discourage "putting off" incorporation of Changes, which have presented a problem on more than one occasion. Publications that were not current have been used to perform maintenance tasks resulting in situations that are potential flight safety hazards.

Quality Assurance is charged with the responsibility of making periodic spot checks of each work center's publications to ascertain that the publications are updated properly.

NOTE: That portion of the text affected by the current Change or Revision is normally indicated by a heavy vertical line in the outer margin of the page.

Conversion Of Manuals To Microfilm

A relatively new concept in supplying maintenance activities with certain types of technical data has been accomplished by the use of microfilm. As a means of improving updated manual availability and reducing storage space numerous maintenance manuals and illustrated parts breakdowns are being placed on 16mm microfilm. The microfilm is stored in cartridges and a label on the cartridge indicates the numbers of the manuals inclosed. In the future it is intended that microfilm will be issued to users in lieu of hard copy manuals.

Microfilming is the photographic art of reproduction of text or pictures at ratios of reduction too great for reading or viewing without optical assistance. A reader or some type of projector is required in order to enlarge the microfilm for reading.

There are many different makes and models of microfilm readers and reader printers. Some have printing capabilities while others do not. Those with the printing capability generally will provide a permanent copy in a matter of a few seconds. Coverage of the operation of all the various models is not appropriate for this training manual. The Filmac 400C model covered in this section is widely used in the Navy.

The Filmac 400C cartridge reader printer (fig. 2-1), manufactured by the Minnesota Mining and Manufacturing Company, provides a fast means of viewing 16mm cartridge microfilm and also prints a copy of the frame being viewed in a matter of seconds. This particular model is practically automatic; therefore, very little training is required to properly operate and maintain it. Like any delicate machine, the operating instructions provided by the manufacturer should be closely followed and the machine should not be abused.

The 400C reader printer operates on standard 110-volt alternating current. It is controlled by an ON-OFF switch located above the viewing screen on the front of the machine. This switch controls the projection lamp, which illuminates the viewing screen and also the cooling blower.

This machine incorporates an automatic microfilm threading process; therefore, loading and threading microfilm is a simple task. Loading a cartridge of microfilm into the machine consists of inserting the cartridge into the holder with the open end toward the right. The cartridge is then pressed flat against the holder until the cartridge lock clicks. Threading is accomplished by turning the speed control knob counterclockwise and depressing the thread

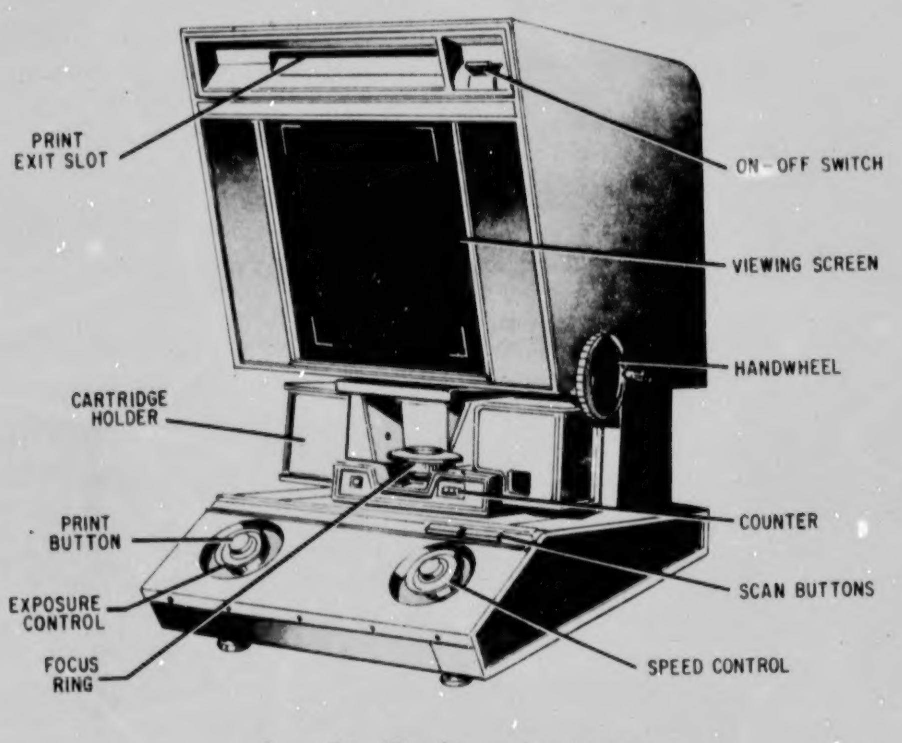


Figure 2-1.—Microfilm reader printer.

lever for approximately 2 seconds, or until images appear on the viewing screen. Microfilm advancement is stopped by returning the speed control knob to the center position.

A counter registers the frames or images as they advance; therefore, by referring to the indexed cartridge, the approximate location of a frame can be determined and the microfilm rapidly advanced until this frame number corresponds to the counter reading. Rapid advancement of the microfilm is accomplished by turning the speed control knob counterclockwise–the farther the knob is turned, the faster the microfilm advances. The microfilm is wound back into the cartridge by turning the speed control knob clockwise.

Scanning a cartridge of microfilm in search of a specific frame can be accomplished by two different ways. One way is by the use of the handwheel located on the right-hand side of the reader printer. The other way is by use of the appropriate scan button. An arrow on each of the two scan buttons indicates the direction of microfilm travel. Once the desired frame is on the viewing screen, the focus ring is used to bring the image into sharp focus.

To make a print or copy of the frame of microfilm being viewed is a simple process. First of all, the image on the viewing screen should be centered and in proper focus. This can be accomplished by use of the handwheel and focus ring. Next, the exposure control knob must be set for proper exposure.

NOTE: Lower exposure control knob settings give light prints, and higher settings give dark prints. Experience with the reader printer will, for the most part, provide the operator with the setting to be used on the exposure control knob.

The print button is then pressed momentarily and the print comes out the print exit slot.

Prior to microfilm cartridge removal, the speed control knob should be rotated clockwise until all microfilm is wound back into the cartridge. To remove the cartridge, simply push back on the cartridge lock and remove the cartridge from the holder.

This reader printer uses a special type of copy paper and will not operate when the supply of copy paper is exhausted. It also uses an activator solution in the printing process. Under normal use, a bottle of activator solution is adequate for one roll of copy paper. It is a good practice to install a new bottle of activator solution each time a new roll of copy paper is installed. The operator's instructions manual provided by the manufacturer gives complete details for loading both copy paper and activator solution. In addition, this manual gives instructions for routine cleaning and maintenance that can be performed by the operator.

PROCUREMENT OF PUBLICATIONS

The publications covered in the previous section are specifically prepared to assist maintenance personnel; however, either through a lack of knowledge of their existence, the procedures for obtaining them, or plain indifference by supervisor personnel, the mechanic is often deprived of the benefits publications are intended to provide. Since the use of publications in performing maintenance tasks is mandatory, they must be on hand and used consistently.

Detailed information concerning the availability of aeronautic publications may be found in the Naval Aeronautic Publications Index. The complete index is made up of five parts, as follows:

NavSup 2002, Section VIII, Parts C and D–Numerical Sequence List.

NavAir 00-500A–Equipment Applicability List.

NavAir 00-500B–Aircraft Application List.

NavAir 00-500C–Directives Application List.

NavAir 01-700–Airborne Weapons/Stores, Conventional/Nuclear, Checklists/Stores Reliability Cards/Manual Index.

NOTE: The latter part is not used by AME personnel and is therefore not covered in this section.

NavSup 2002, Section VIII, Parts C and D, contains a complete numerical listing of all available naval aeronautic publications distributed by NavAirSysCom and stocked for issue as of the date of publication. This numerical listing contains all available publications by publication number, stock number, and title. Publications are subdivided into subject groups according to type of aircraft or equipment, or component thereof.

Part C (manual publications) contains its table of contents, as well as the instructions for using both Parts C and D of NavSup Publication 2002. Included in these instructions are the method for procuring aeronautic publications, the forms and procedures required for ordering publications, and explanations of certain codes used in the Index. Also a listing of canceled publications for Part C is contained in the last pages of Part C.

Part C is divided into subject matter groups, and all publications within a group are then listed in numerical order. For example, all manuals in the 00 series are listed first, then followed by the 01, 02, 03, etc., through the 51 series. The listing includes the publication code number, stock number, title, date of latest issue or revision, security classification, requisition restriction code, and basic or change code.

Part D (letter type directives) contains a table of contents, a general alphabetical cross-reference listing, and a listing of Air Force-Navy code cross-references.

Part D is divided into a number of subsections. Included among those of interest to the AME are general, aircraft, accessories, and support equipment. Listed in the general section are Aircrew System Bulletins and Changes, Aviation Clothing and Survival Equipment Bulletins and Changes, Technical Orders, and Technical Notes. In the aircraft section are listed all Aircraft Changes and Bulletins. The accessories section contains a listing of all Accessories Changes and Bulletins. The support equipment section contains a listing of all Support Equipment Changes and Bulletins.

The Numerical Index must be used to completely identify and, therefore, to order required publications. However, the other parts of the Index (discussed in the following paragraphs) must be used to determine what publications are available for a specific item of equipment and to check the applicability of publications to specific equipment.

When an applicable publication number is found in one of the other parts of the Naval Aeronautic Publications Index, it can be easily located in the Numerical Index. Here, it can be more completely identified as to title and nomenclature, stock number (for manual type publications), security classification, and any restrictions concerning the requisitioning of the publication. In addition, the date of the latest issue or revision of the publication is listed. This provides a means whereby the issue and/or revision dates of the publications on hand in an activity can be checked against the dates listed in the current issue and supplement (discussed later) of the Numerical Index, thus assuring that the publications are current.

Equipment Applicability List

Basically, the Equipment Applicability List, NavAir 00-500A, is a cross-reference index listing of Naval Air Systems Command (NavAirSysCom) publications of aircraft components and related equipment according to model, type, or part number.

Since this index contains several thousand entries, one volume would be very cumbersome to use. For this reason, this index is divided into several volumes. At the time of this writing, there are seven volumes.

With the exception of several small sections in the first part of Volume 1, the Equipment Applicability List is one continuous index of model, type, or part numbers in alphanumerical sequence.

In addition to an Introduction, which explains the headings at the top of each page, the other sections in the first part of Volume 1 pertain primarily to manuals for aircraft, weapons systems, and aircraft engines. Therefore, the publication numbers are listed according to aircraft, aircraft engine, and weapons system designation.

The Equipment Applicability List should be used when attempting to determine what publications and technical directives are available on a particular item of equipment, and the manufacturer and part number of the item are known.

Aircraft Application List

The Aircraft Application List, NavAir 00-500B, contains a listing of all manuals grouped according to their application to an aircraft. This part of the index does not contain listings of any letter type publications, and all manuals are listed by publication code number only.

A list of basic numbering categories is provided in the front of the book. This list may be used in determining the general type of equipment covered in a publication. For determining the specific item of equipment covered by a publication and the title of the publication, reference should be made to Part C of Section VIII in NavSup Publication 2002.

The Aircraft Application List is especially handy for determining what manuals are available for a particular model of aircraft. Included under each model is a complete listing of applicable manuals. This listing includes all allowance lists, aircraft manuals, engine manuals, accessories manuals, etc., pertaining to that particular model of aircraft.

Directives Application List By Aircraft Configuration

The Directives Application List by Aircraft Configuration, NavAir 00-500C, contains a listing of the active Naval Air Systems Command letter type technical directives with respect to their applicability to aircraft. The lists in this volume are arranged first by aircraft series, second by aircraft configuration, and third by Airframe/Aircraft Bulletin and/or Change numbers.

NOTE: Configuration refers to modifications made to a basic aircraft model. For instance, A-4A, A-4B, TA-4F, etc., are all different configurations of the A-4 aircraft model.

Each list in the Naval Aeronautic Publications Index is updated at regular intervals by the issuance of a new list. In addition, some of these Lists are kept current by the periodic issuance of supplements between issues of the Basic List. The dates and intervals of the issuance of new Lists and supplements have changed from time to time in the past.

At the time of this writing, the Numerical Index (Parts C and D of NavSup Publication 2002) is issued annually in September. Supplements are issued bimonthly between each basic issue. The Equipment Applicability List, NavAir 00-500A, is issued annually in November. This List is kept current by the issuance of quarterly supplements between each basic issue. The Aircraft Application List, NavAir 00-500B, is issued in March and September, and the Directives Application List by Aircraft Configuration, NavAir 00-500C, is issued in January and July of each year. Supplements are not issued for these Lists.

Supplements list all aeronautic publications distributed during the previous period, and those publications that have been superseded, canceled, or revised. Supplements are cumulative, that is, all material from the preceding supplement is incorporated in the latest supplement; therefore, at any given time, not more than one supplement is in effect for any List. Naturally, the reissue of a basic List cancels the outstanding supplement.

Supplements for the Numerical Index (Parts C and D of Section VIII of NavSup Publications 2002) are identified by the word "supplement" printed near the upper right-hand corner of the cover. Supplements to the NavAir 00-500A Series publications are identified by the word "supplement" printed in the middle of the cover page.

Procurement Methods

There are 5 main methods of procuring publications relating to naval aircraft maintenance.

The first method is initial outfitting. The Naval Air Technical Service Facility will provide the prospective commanding officer of a newly commissioned or reactivated ship, station, or activity an outfitting of general aeronautic publications. Normally this outfitting will be furnished 2 months prior to commissioning unless otherwise requested.

The second method is aeronautic technical publication outfitting. An Aeronautic Technical Publication Outfitting Allowance consists of those publications applicable to a particular model of aircraft. Initial distribution is provided by the Naval Air Technical Services Facility to a newly commissioned or reactivated activity. Upon change in mission or aircraft custody which requires a different set of publications, the activity must submit a request to the Naval Air Technical Services Facility for an Aeronautic Technical Publication Outfitting Allowance, applicable to the model designation of the aircraft involved.

The third method of procuring publications is through inclusion on automatic distribution lists. The Naval Air Technical Services Facility normally provides for the distribution of certain future issues of new and revised publications directly to affected activities. Activities desiring to receive future issues of new and revised publications must submit NavAir Form 5605/3, Mailing List Request for Aeronautic Publications, to the Commanding Officer, Naval Air Technical Services Facility, 700 Robbins Avenue, Philadelphia, Pennsylvania 19111. AME work center supervisors desiring to receive particular issues, reissues, and revisions of publications should make their requirements known to the maintenance office and/or the activity's technical publications library so that they may be included on the next submission of NavAir Form 5605/3.

NAVAIR Form 5605/3 consists of four separate parts:

Part I contains requirements for General Allowance Lists, Indexes, and General Series Technical Manuals and Directives.

Part II contains requirements for Aircraft/ Engine Allowance Lists, and Airframe and Power Plant Technical Manuals and Directives.

Part III contains requirements for Aircraft Component Manuals.

Part IV contains requirements for Ship Installation Technical Manuals and Directives.

Instructions for submission of NAVAIR Form 5605/3 are printed on page I of each part. The parts may be submitted separately or as a group, as long as the appropriate block in the instructions is checked to indicate the reason for submission. The newly submitted form will place an activity on the mailing list for FUTURE ISSUES of Basic, Revised, or Changed manuals/ directives only. It is not used as an order blank for existing manuals/directives.

The fourth method of procuring publications is by ordering individual publications direct. The Single Line Item Requisitioning System Document (DD Form 1348 or DD Form 1348M) is used by activities when requisitioning manual type publications on a one-time requirement. Letter type publications may be ordered on DD Form 1149 Standard Requisition and Invoice/ Shipping Document, on a one-time requirement. The use of DD Form 1348, DD Form 1348M, or DD Form 1149 will not result in being placed on the distribution list to receive future issues or revisions of the publication ordered. Unless otherwise directed, individual publications are ordered from the Commanding Officer, (1051), Naval Publications Form Center (NPFC), 5801 Tabor Ave., Philadelphia, Pennsylvania 19120.

A limited number of publications may be ordered utilizing telephone requisitioning procedures. This is accomplished by contacting the customer service branch of the Naval Publications Forms Center. The same information as would be placed on an order form should be obtained prior to placing the telephone call, thereby improving accuracy and expediency over this communications media.

Although Interim Changes and Bulletins are listed in NavSup Publication 2002, Section VIII, Part D, they are not available for issue through the Publications Supply System. They are listed only for informational purposes.

Operating activities requiring copies of Interim Technical Directives should submit requests to the appropriate controlling custodian. Other activities requiring copies of ITD's in addition to the initial NavAir distribution, should submit requests to the appropriate Naval Air Systems Command Representative.

Instructions issued by Washington headquarters organizations such as OpNav, BuPers, SecNav, NavAir, etc., are listed in the Consolidated Subject Index of Unclassified Instructions, NAVPUBINST 5215 Series. They are requested on NavSup Form 1205 from the Supply and Fiscal Department, Washington, D.C.

Requests for instructions from other than Washington headquarters organizations may be initiated on NavSup Form 1205 by submitting a letter request in accordance with the originating activity's 5215 index of instructions.

NavAir Specifications and Standards and NavAir Standard Drawings are listed in NavAir 00-25-544 and NavAir 00-25-543, respectively. The Department of Defense Index of Specifications and Standards (DODISS) and related documents, Part I*(alphabetical listing) and Part II (Numerical listing) provide a more complete listing of specifications and standards of interest to work center supervisors. Specifications, standards, and drawings are ordered on DD Form 1425.

In addition to the NavAirSysCom, other commands publish a variety of material which may be useful. There is no hard and fast rule for procurement of this material. If the item desired is not listed in the cognizance symbol I catalog (NavSup 2002) and no other source is known, send the request by letter directly to the publishing command.

Fleet and type commanders publish a limited amount of material, normally relating to operational problems in their respective areas. This material is usually supplied automatically to activities on the standard mailing list. If other requirements exist, a letter request may be submitted to the applicable fleet or type commander.

Situations may arise in both Organizational and Intermediate levels of maintenance which require the use of engineering drawings. Technical information of this type is normally supplied to these levels of maintenance in the form of microfilm reproductions of the actual drawings. Engineering drawing reproductions provide all the necessary information to construct, assemble, and install a part or an assembly. Aircraft and equipment manufacturers provide NATSF and Naval Air Rework Facilities with engineering drawings for use by engineering and repair personnel. These activities are also provided with microfilm and Vandyke (blueprint) copies of engineering drawings.

For the most part, microfilm copies of engineering drawings are provided in filmstrip and in single frames mounted on aperture cards. Aperture cards are standard size EAM cards and have printed and keypunched identifying information concerning the frame of microfilm which they contain. It is conceivable that reproductions of engineering drawings may, in the future, be provided in cartridge form for use by the Filmac 400C reader printer previously discussed.

Most aircraft and equipment IPB's contain manufacturer's engineering drawing numbers for various components. If microfilm of a particular drawing is required and the drawing number unknown, then the aircraft or equipment company technical representative should be consulted for this information.

In most cases the requirement for microfilm will be on an as-needed basis; therefore, large stocks will not normally be maintained in the technical library of Organizational and Intermediate activities. The various work center supervisors will normally notify the person in charge of the technical library of their requirement for microfilm.

All requests for complete sets of engineering drawings should be forwarded to the Commanding Officer, U.S. Naval Air Technical Services Facility (EDD), 700 Robbins Avenue, Philadelphia, Pennsylvania 19111, on a DD Form 1149. When a complete set of drawings for an aircraft of equipment is requested, the individual drawings need not be listed; however, the request must be accompanied with a statement of justification. Individual drawings may be obtained either from NATSF or the nearest NAVAIRREWORKFAC, via the cognizant NAVAIRSYSCOMREP. Requests for classified and unclassified drawings must be submitted on separate forms. Since approximately four and a half million drawings are available from NATSF, proper submission of requests for copies of these drawings is essential to avoid delay in receipt.

SECURITY OF CLASSIFIED PUBLICATIONS

The problem of security of classified publications in the work center files is generally limited to ways and means of stowing, using, accounting for, and disposing of such publications in accordance with existing directives. The basic Navy security directive relating to the safeguarding of classified information is the Department of the Navy Supplement to the DOD Information Security Program Regulations, OpNav Instruction 5510.1 (Series). Its provisions apply to all military and civilian personnel and to all activities of the Naval Establishment. The application of security measures regarding work center files may be further influenced by locally issued directives which supplement the basic directive.

All personnel in the Navy Establishment are individually responsible for assuring that knowledge of classified information which they prepare or handle is made available only to persons who have clearly established a legitimate "need to know." Classified material is procured for the files because it is needed during the performance of some related maintenance function. Use of these publications by AME personnel should be anticipated and steps taken to procure security clearances for selected personnel most likely to require the information.

The supervisor must initiate procedures that insure him positive control of all classified publications for which he is custodian. The first problem of custody is stowage. The Navy Security Manual discusses stowage containers of varying degrees of integrity. Also provided in the manual are specific requirements for safeguarding combinations and keys for locks, as these, to various extent, affect the protective capabilities of the different types of containers.

Classified publications that are no longer required in the work center or that have become obsolete should be returned to the Classified Material Control Officer for disposition by transfer or destruction, as appropriate.

Commanding officers are responsible for establishing security orientation, education, and training programs for all personnel assigned. OpNav Instruction 5510.1 (Series), chapter 3, provides the necessary minimum requirements for implementing these programs.

The central aim of the security education program is to make all personnel "security-minded." To achieve this, a continuing training program must be in use at all levels of the command, with emphasis by the senior petty officers to their subordinates.

Effective security also requires that the handling of classified materials be managed in an efficient manner. Good management practices are important in obtaining effective security control. If security needs are to be met, constant attention must be given to the way in which classified material is handled. The guide for handling and control of classified material is OpNav Instruction 5510.49 (Series).

Security Orientation, Education, And Training Program

The security orientation, education, and training program of each command must include all personnel entrusted with classified information regardless of their position, rank, or grade. The program must be designed to include the following:

1. Familiarize all personnel with the security requirements with which they have to comply for proper performance of their duties and assignments.
2. Remind all echelons of command of their responsibility for assuring that classified defense information is effectively and economically safeguarded.
3. Insure willing, conscientious compliance with security regulations, procedures and practices.
4. Remind all echelons of command of their responsibilities in the classification management program to include classification, upgrading, downgrading and declassification processes as set forth in OpNav Instruction 5510.1 (Series).
5. Advise all personnel who have access to classified information of the hazards of its disclosure to any person not authorized to receive it and of their responsibility for exercising personal vigilance for its protection.
6. Inform all personnel of the techniques and devices employed by foreign intelligence activities in attempting to obtain U.S. classified defense information and of their responsibility for reporting such attempts.
7. The attention of all personnel must be directed to the disciplinary action (Article 0815 of OpNav Instruction 5510.1 (Series)) that may result from violation of security regulations.

Personnel Indoctrination

Persons being assigned to duties requiring access to classified information, prior to being granted access, must be indoctrinated on the security aspects and responsibilities of their assignment. The indoctrination must include the strict prohibition against discussing classified information over the telephone. This is especially important because of the fact that many calls are transmitted through microwave transmitters and can be easily recorded and analyzed. The types of situations to be avoided when talking on the telephone are:

1. Allowing classified information to slip into conversations through carelessness.

2. Disclosure of classified information in order to expedite the completion of a "rush project."

3. Use of codes, "double talk" or attempt to talk around classified information. It should be noted that private codes and "talking around" classified matters presents no real protection against the abilities of a trained analyst.

As part of the indoctrination program, personnel must be instructed to report promptly any of the following types of information:

1. Attempts by representatives or citizens of communist controlled countries to cultivate friendships or to place personnel under obligation.

2. Attempts by representatives or citizens of foreign governments to:

a. Cultivate a friendship to the extent of placing them under obligation, which they would not normally be able to reciprocate, or by money payments or bribery to obtain information of intelligence value.

b. Obtain information of intelligence value through observation, collection of documents, or by personal contact.

c. Coerce personnel by blackmail; by threats against or promises of assistance to relatives living under their control, especially those in a communist country.

d. Appeal to personnel on a racial, nationalistic, or ideological basis.

e. Exploit personnel who may be disaffected or in personal difficulties.

f. Intimidate, harass, entrap, discredit, search, spy on, or recruit for intelligence purposes personnel traveling in communist countries.

g. Induce personnel to defect or to induce those who have fled from communist countries to redefect.

3. Attempts by Department of the Navy personnel to provide unauthorized services, information, or documents to anyone believed to be in contact with a foreign intelligence service.

4. Attempts by persons living in communist countries to obtain information of intelligence value from personnel by correspondence (including "Pen Pal" correspondence), questionnaires, "ham radio" activity, naval cachets (request to service postal covers), or other forms of communications.

5. Careless handling of classified material and failure to properly secure classified material containers.

Senior petty officers to whom information of the above nature becomes known must:

1. Instruct the reporting individual to take no action to exploit, apprehend, restrict, or stimulate further contact until appropriate guidance or instructions are received.

2. Report full details expeditiously to the commanding officer who should report his findings to the nearest Naval Investigative Service Officer or take whatever appropriate action is required, dependent on the nature of the violation.

WORK CENTER FILES

There are two general categories of records required of all work center supervisors. These include records required by the activity for operation purposes and those needed by the supervisor for the efficient management of his work center. It is advisable to keep the system of records as simple as possible and still maintain the necessary control. Too many records can lead to duplication, wasted manhours, outmoded instructions, and in general complicate what should be a simple, workable, work center file system. On the other hand too few records can lead to uncertainty, encourage guessing, and sometimes lead to embarrassing situations.

Retention of obsolete and inactive correspondence and records is costly. Such correspondence and records should be destroyed or transferred in accordance with approved records disposal instructions. If this is not performed periodically, the volume of file space required becomes excessive and the files become unwieldy, thus inefficient. The destruction of records is governed by law which requires authorization by proper authority. The authority for destruction of Navy records is contained in SecNav Instruction 5212.5 (Series), Disposal of Navy and Marine Corps Records.

The provisions of SecNav Instruction 5212.5 (Series) are normally amplified by the issuance of local instructions outlining the procedures as they apply locally.

Not all materials in the files have a record characteristic. In fact, most printed matter found in the maintenance department general files fall in the category of nonrecord material. This includes documents that are copies of those filed in the activity's administrative department or other material that has been reproduced and never acquired a record characteristic themselves.

SecNav Instruction 5212.5 (Series) (part II for shore stations and part III for ships) contains the retention standard for naval records. Record materials are listed by broad subject and the retention period is furnished. Nonrecord material may be destroyed locally as soon as it has served its purpose. Records material may be destroyed upon completion of the retention period.

Unclassified records or nonrecords material authorized for destruction may be placed in wastebaskets and disposed of in the normal manner for trash. Classified material authorized for destruction is turned over to the classified material control officer for disposal. Classified material is destroyed by burning or in some cases by shredding so that reconstruction of the material is impossible. Destruction is accomplished in the presence of two designated witnesses who must have clearances at least as high as the category of material being destroyed.

In order for records to be of maximum benefit and provide adequate control, it is necessary that they be filed in the work center in such a manner that they may be quickly located and readily available for use by all personnel concerned; this includes technical publications.

The Navy has adopted a filing system which provides a definite place for every piece of correspondence and uniformity in filing systems throughout the Naval Establishment. This filing system is an integral part of the Navy Directives System (SecNav Instruction P5215.1 Series). The standardized filing system is based on assigning numbers to the correspondence according to its subject. SecNav Instruction P5210.11 (Navy Marine Corps Standard Subject Classification System) lists the subject numbers, and they are standard for all Navy activities.

While directives (Instructions and Notices) utilize the standardized subject classification system, many other publications do not. When file material other than Instructions and Notices is received in the work center, it should be assigned a file symbol (subject classification number) based on the subject group classification system. The correct application of file symbols assures uniformity in filing.

Personnel who have a working knowledge of the subject classification system and the manner in which all records are filed can locate required material more expeditiously at any activity to which they may be assigned.

The most important step in recordkeeping is classifying (assigning file symbols) since it determines where papers are to be filed so that they may be located quickly. Each paper received in the work center that must be kept for filing should have the work center file symbol assigned regardless of whether or not a file symbol already appears on it. The proper classification should be determined by the most important, definite, or concrete subject mentioned; the purpose or general significance of the document; the manner in which similar documents are sought; and the file symbol under which other documents of a similar nature are filed.

The actual filing responsibility should be assigned to one person in the work center. All material awaiting filing should be placed in one basket only, and to avoid accumulations, should be filed daily.

In addition to proper filing, another handy tool for keeping work center files in good order is the "file out" card. This may be a locally prepared form that is inserted into the files whenever a piece of file material is charged out to another office, work center, or person, to help keep track of its whereabouts. All "file outs" should be checked periodically to prevent misplacement of material. Care must be taken that records are not released to unauthorized persons.

Filing of publications such as technical manuals should be done by use of looseleaf binders. These publications should be placed on looseleaf binders in numerical order and kept in a convenient shelf. The binders should be clearly marked on the back with the contents for ease in locating a particular publication or directive.

REQUIRED READING AND MAINTENANCE INFORMATION RECORD

Certain directives and publications are routed to the various work centers as maintenance information, and copies of such maintenance information must be disseminated and retained until it is no longer applicable. Information should be placed in a required reading file that is available to all hands in the work center. When new material is received, it is placed in the "active" required reading file until it is read and initialed by each man in the work center. It may be necessary for the work center supervisor to amplify or clarify some information so that it will be properly understood.

Once all personnel in the work center have read and initialed the material, it is placed in the "standing" required reading file for use in indoctrinating new personnel and for periodic review by those personnel who may require it. Newly assigned personnel should read and initial both the active and standing file. If copies of directives or publications are not available for the required reading file, a cross-reference sheet indicating the general content of the subject matter and its location is utilized to insure that personnel are thoroughly aware of all information that could affect their actions.

PERSONNEL MANAGEMENT

One of the problems that a supervisor will encounter is that of personnel management. The supervisor must realize the importance of long range planning to insure that his personnel are trained and available to complete scheduled deployments.

To assist the operating activities in their personnel management, a Manpower Authorizations, OpNav Form 1000/2, is furnished each activity listing by pay grade and NEC the number of personnel authorized. The authorized manpower is the result of extensive study by NavAirSysCom; it is based on the weapons system, the type of operations being conducted, and the recommendations of the supplying contractor.

It is the responsibility of the supervisor to compare both the number and grade of personnel and their NEC's with the authorizations. Any variation in the two should be reported to the department/division officer as appropriate with recommendations based on facts.

If the manpower authorizations differ (in number, pay grade, or NEC) from actual requirements of the organization and this difference cannot be corrected by training, this should be reported to the department/division officer. A Manpower Authorization Change Request, OpNav Form 1000/4A, should be initiated to request appropriate changes. OpNav Instruction 1000.16 (Series) provides instructions for preparation of Manpower Authorization Change Requests.

A document which the supervisor should utilize in the management of personnel is the Enlisted Distribution and Verification Report (BuPers 1080-14). This monthly report, which is normally maintained in the Enlisted Personnel Office, contains a multitude of information such as expiration of enlistment, time in service, NEC codes, and projected rotation month. For those activities classified as shore duty, the tour completion date reflects the month and year a man is to be transferred; for sea duty activities, the report indicates the month and year that the man's sea duty commenced.

Personnel who have been ordered to report for duty are also covered by the report.

Utilization of this report by the AME supervisor permits long range personnel planning for school quotas, leave, and rotation of billets within the division or work center.

SCHEDULING AND ASSIGNMENT OF WORKLOADS

Among the most important factors with which the Chief or First Class Aviation Structural Mechanic E is concerned as a supervisor are the assignment and accomplishment of the scheduled workload. His objective is the satisfactory completion of assigned tasks in a reasonable length of time, utilizing available men and materials as efficiently as possible. In order to achieve his objective, the supervisor must become skilled in estimating the amount of time to allow for the completion of each task and estimating the number of workers required. He must realize the importance of assigning both qualified and unqualified men to the jobs, consistent with his training program. The supervisor must allow for planned interruptions and yet not operate on so tight a schedule that minor, unplanned interruptions completely disrupt his schedule.

MALFUNCTION ANALYSIS

The amount of time required to analyze malfunctions will have a direct relationship on the length of time that will be required to effect repairs of an unscheduled nature. The length of time required to analyze a malfunction will depend on several factors: the experience level of personnel assigned to the job, availability of test equipment, availability of replacement parts, the nature of the malfunction, the thoroughness of troubleshooting/trouble analysis charts and procedures provided in the Maintenance Instructions Manual, etc. The cause of some malfunctions can be elusive and difficult to pinpoint. The supervisor who is familiar with the weapon system or equipment and makes full utilization of his experience and knowledge will be able to provide realistic estimates on trouble analysis and repair times. Documenting excessive or significant troubleshooting time separately from actual repair time will provide recorded maintenance data that can be utilized for such estimates. The procedures involved in malfunction analysis are covered throughout this manual.

ESTIMATING TIME AND PERSONNEL REQUIREMENTS

Most aircraft maintenance jobs are of such a nature that the quality and quantity of people assigned to do them directly affect the time that will be required for completion. For this reason, time requirements and personnel requirements are combined and discussed together in this section.

Probably the most important single aid in estimating time and personnel requirements for aircraft maintenance tasks is the Maintenance Requirements Cards. Extensive time and motion studies of the various inspection requirements have been made and completion times are furnished in manhours or manminutes. These times also reflect routine maintenance adjustment, and replacement if required in connection with the aircraft inspection. They are calculated on the basis that the most efficient number of men are continuously employed and that all necessary equipment, tools, and parts are immediately available. The supervisor must consider all these factors from the knowledge of his individual personnel, supply, and equipment situation, together with an accurate determination of the extent to which the maintenance task at hand exceeds the inspection requirements if he is to reliably predict the completion time. While this procedure may seem rather involved at first, the new supervisor will find that it is based on sound management principles and that, with experience, his ability to accurately predict time and personnel requirements will speedily improve.

Maintenance procedures in most Maintenance Instructions Manuals provide the recommended manpower requirements but not the estimated time to accomplish the task. The ability to estimate the time required to complete various tasks will come through experience and reference to maintenance data forms which might reflect the time required to complete previous discrepancies of a similar nature.

PERSONNEL WORK ASSIGNMENTS

Work assignments should be rotated so that each man will have an opportunity to develop his skills in all phases of the AME work. When assignments are rotated, the work becomes more interesting for the men. Another good reason for rotating work assignments is that if one highly skilled man performs all the work of a certain type, the supervisor and the work center would be at a great disadvantage in the event the man is transferred. Less experienced personnel should be assigned to work with him in order to become proficient in his particular skill. Also, in order to broaden his knowledge of his rate, the expert on one job should be rotated to other tasks when there is no immediate need for his particular skill.

Strikers should be assigned to various tasks so that they will acquire experience on all kinds of jobs. A special consideration for the assignment of strikers to jobs is that they should be assigned progressively to jobs of ascending levels of difficulty. A striker may be a useful assistant on a complicated job, but he may not understand what he is doing unless he has worked his way up from basic tasks.

ALLOWING FOR PLANNED INTERRUPTIONS

During an average workday, occasions will arise when personnel have to leave their working spaces for one reason or another, thereby delaying the completion of the scheduled work. Some delays can be anticipated; some cannot. Among the delays which can be anticipated are training lectures, immunization schedules, flight schedules, rating examinations, meals, and watches or other military duties.

Before making personnel work assignments the supervisor should determine what delays can be anticipated. It may be possible to arrange assignments so that work interruption is held to a minimum. When estimating the completion time of an aircraft maintenance task, the supervisor should allow for these predictable delays.

INSPECTION OF COMPLETED WORK

All work completed by the work center is subject to inspection by the squadron or unit quality assurance representatives. This fact in no way relieves the work center supervisor of the responsibility for checking on the quality of work accomplished by his work center. Frequent inspections should be made during the progress of the work as well as after completion. The supervisor's inspection should provide affirmative answers to the following questions:

1. Is the work done according to current directives?
2. Do technical materials used conform to specifications?
3. Is the job complete in all respects?
4. Does the workmanship measure up to desired standards?

When parts or components are removed or installed, the supervisor should insure that the necessary functional checks are performed in accordance with the existing directives.

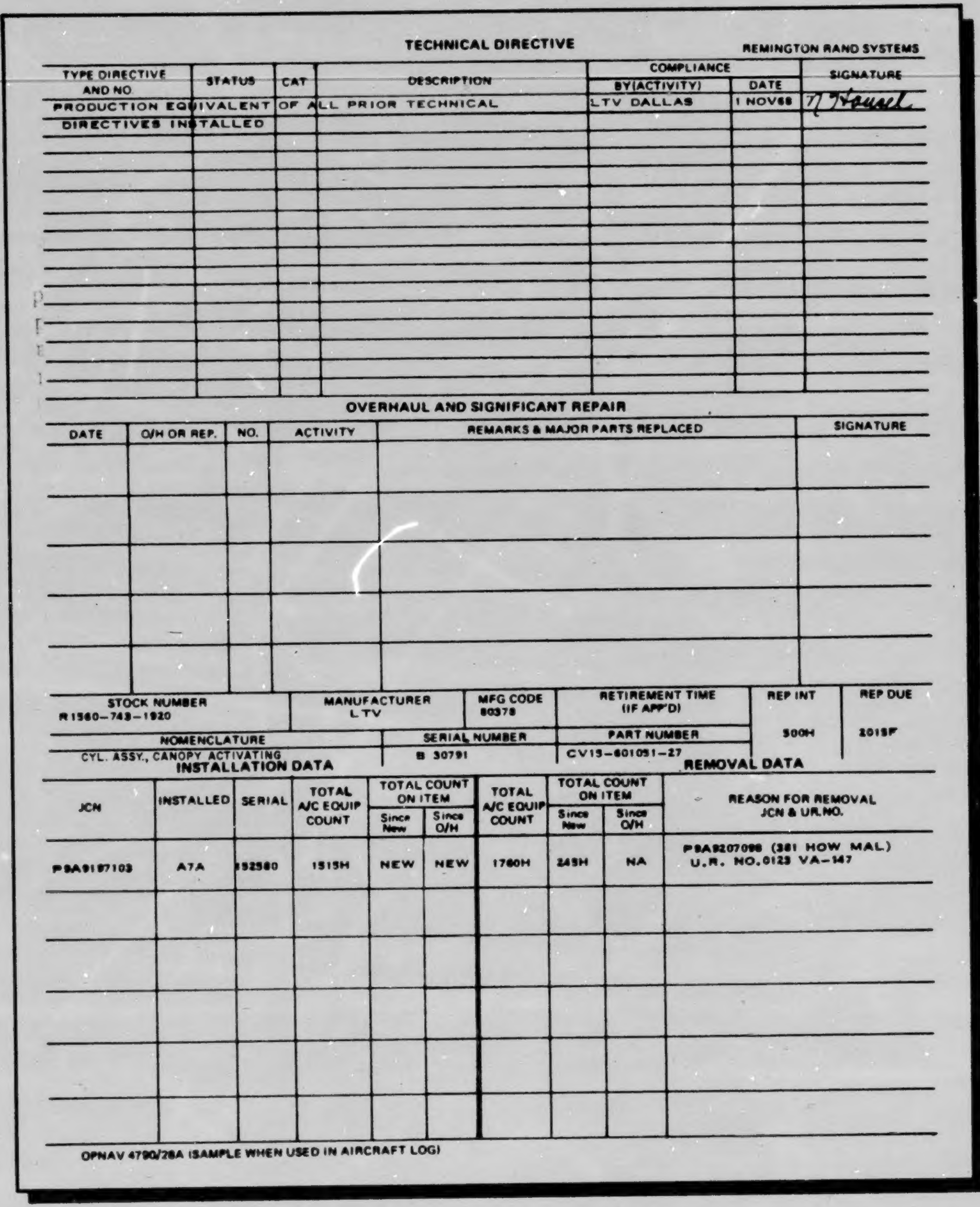
When an aircraft maintenance job has been finished, the crew leader is required to complete the Maintenance Action Form. An important function of the supervisor is the review and evaluation of the completed MAF. The purposes of the supervisor's review and evaluation are listed below, not necessarily in order of importance:

1. Determine completeness. Ascertain if entries are made in every space required of his work center.
2. Evaluate the items on the completed MAF's which indicate that discrepancies have been found and corrected or parts replaced. Ascertain if causes were determined for each discrepancy and evaluate correctness of steps taken to eliminate these causes. Determine if any combination of discrepancies indicates improper operation or incipient failure of a related part, component or assembly.
3. Note manhours expended. Determine if estimated maintenance time is realistically reflected in the crew leader's report of manhours used. This may be used as a rough indication of the efficiency of the inspection crew.

On certain aircraft components and accessories an accurate and complete maintenance history including installation, removal, operating time, technical directives complied with, etc., is required. The Scheduled Removal Component Card (SRC) illustrated in figure 2-2 is designed to provide the necessary history information. Components requiring an SRC are listed in the Periodic Maintenance Information Cards (PMIC) for each specific aircraft.

The cards are maintained in the Aircraft Logbook or the Aeronautical Equipment Service Record (AESR) located in the maintenance control work center. The AESR is a loose-leaf log contained within a separate cover. Presently, the only specific equipments pertaining to the AME that require an AESR are low level ejection systems.

When a component is removed from the aircraft the SRC Card or, if applicable, the complete AESR must be properly annotated and accompany the component. As it is processed through the supply channels and higher levels of maintenance for repair, incorporation of technical directives, and ultimately returned to a ready-for-issue condition, the card must ac-



TECHNICAL DIRECTIVE REMINGTON RAND SYSTEMS

TYPE DIRECTIVE AND NO	STATUS	CAT	DESCRIPTION	COMPLIANCE BY(ACTIVITY)	COMPLIANCE DATE	SIGNATURE
PRODUCTION EQUIVALENT OF ALL PRIOR TECHNICAL				LTV DALLAS	1 NOV68	Hausel
DIRECTIVES INSTALLED						

OVERHAUL AND SIGNIFICANT REPAIR

DATE	O/H OR REP.	NO.	ACTIVITY	REMARKS & MAJOR PARTS REPLACED	SIGNATURE

STOCK NUMBER R1560-743-1920	MANUFACTURER LTV	MFG CODE 80378	RETIREMENT TIME (IF APP'D)	REP INT 500H	REP DUE 2015F
NOMENCLATURE CYL. ASSY., CANOPY ACTIVATING		SERIAL NUMBER B 30791	PART NUMBER CV13-601051-27		

INSTALLATION DATA **REMOVAL DATA**

JCN	INSTALLED	SERIAL	TOTAL A/C EQUIP COUNT	TOTAL COUNT ON ITEM Since New	TOTAL COUNT ON ITEM Since O/H	TOTAL A/C EQUIP COUNT	TOTAL COUNT ON ITEM Since New	TOTAL COUNT ON ITEM Since O/H	REASON FOR REMOVAL JCN & UR.NO.
P9A9197103	A7A	152580	1515H	NEW	NEW	1760H	245H	NA	P9A9207098 (381 HOW MAL.) U.R. NO.0123 VA-147

OPNAV 4790/28A (SAMPLE WHEN USED IN AIRCRAFT LOG)

AM.2

Figure 2-2.–Scheduled Removal Component Card.

company the component so that there is a continuity of the maintenance history recorded.

When a replacement part that requires an SRC card is received by a maintenance activity the SRC card should either be attached to the component or inside the box or container in which the component is shipped. The SRC card should always be placed in a plastic return material documents envelope separate from other shipping documents. Components that are received without the required SRC card should not be considered as ready for issue by supply or accepted for installation by the maintenance activity.

Since many SRC cards have been lost in the past, special handling is necessary to reduce the possibility of loss. Such losses have a definite impact upon the logistics assets available to using activities, overhaul scheduling, and loss of usable operating time on the component.

Cards received with replacement components should be immediately turned over to the activity's maintenance production control work center for inclusion in the appropriate Aircraft Logbook or Aeronautical Equipment Service Record. Maintenance personnel finding any SRC card that is separated from its associated component should turn it in to the maintenance control work center. If local attempts to locate the associated component fail, the card is forwarded to the central repository for SRC cards in accordance with OpNav Instruction 4790.2 (Series).

Entries on the SRC cards are made by designated personnel of the AZ rating or other designated and qualified personnel assigned to the maintenance control work center. The AME supervisor should insure that all personnel in his work center are aware of the necessity of proper handling of the SEC cards to reduce the possibility of their loss.

WORK CENTER QUALITY ASSURANCE

Commanding officers are responsible for the inspection and quality of material under their cognizance. In a maintenance department, the principal force for securing compliance with quality standards lies NOT in the instruments, instructions, or other facilities for inspection, but in the state of mind of maintenance personnel, from the commanding officer down to the plane captain.

Generating quality in a maintenance organization necessitates a sincere interest on the part of commanding officers, plainly evidenced to the officers and men in their commands. Quality further requires that each maintenance officer and supervisor understands clearly how the accomplishment of a quality job contributes to the effective operation of the organization. Quality also requires each maintenance worker understands not merely a set of specification limits, but also the intent and the need for these requirements.

To be effective, an activity's quality assurance program must be well formulated, then followed in an active, aggressive, continuous, and positive manner. The attitude of the work center supervisor towards support of quality assurance should be such that all work center personnel will understand the program and give it their full support. Instituting and maintaining a good quality assurance program is not a simple task but it is a "must" if maintenance caused mishaps are to be reduced.

FUNCTIONAL AREAS

The quality assurance organization is concerned with three functional areas—quality management, quality verification, and technical publications.

Quality management is monitored by formulating, implementing, and auditing procedures, instructions, and operations to assure compliance with the policies stated or implied within the NAMP Manual. Quality assurance coordinates their efforts with those of the activity's data analysis group to provide information on maintenance practices and results based on facts gleaned from the various maintenance source documents and associated reports.

Quality verification assures that all materials processed and actions taken by maintenance personnel meet prescribed quality requirements. Direct inspection of material and operations as they are performed is necessary on a continuing basis to give adequate assurance that all items processed and maintenance tasks completed meet the prescribed requirements. These quality assurance considerations (tests, inspection, etc.)

are included in most weapon system Maintenance Requirements Card decks as well as most Maintenance Instructions Manuals and Overhaul and Repair Manuals (03). Quality assurance verification steps are generally called for at various steps during repair progress in addition to verification of the final product.

Since technical information has a direct relationship towards assuring the quality of work performed, the quality assurance division has the responsibility of operating a master technical library and monitoring of dispersed libraries within the various work centers. Dispersed libraries located within the work centers are necessary to place technical information in the hands of the user who is charged with compliance. The quality assurance division monitors the operation of these dispersed libraries, providing new publications, revisions, cancellations, and such other information that may affect the publications held. A change entry certification form is utilized to insure that all change and revision material is entered into the directives and manuals of the dispersed libraries within a reasonable time.

Since the responsibility area of the supervisor is the middle ground between management and men, it is incumbent upon him to initiate and administer a quality assurance program. His main objective is to improve the state of training of his men until their mental attitude is such that top quality workmanship becomes second nature. How successful he is in achieving this objective will be determined by his ability and insight in the following areas:

1. The assignment of the proper number of qualified men to do the jobs plus on-the-job trainees.
2. Making provisions for adequate on-the-job supervision and inspection.
3. Allowing adequate time to perform safe, high quality jobs.
4. Assuring himself that current directives and publications on safety and aircraft model concerned are available and complied with.
5. Monitoring the training program with respect to timeliness and completeness of coverage. Eliminating out-of-date training material promptly and introducing important new material as soon as possible after receipt without regard to lesson schedules.

These procedures should result in high quality workmanship by work center personnel and meeting of specifications and quality standards in the work.

Personnel to be designated as inspectors should possess the following attributes.

1. Should be experienced and fully knowledgeable within his technical rating.
2. Should possess the ability to research, read, and interpret drawings, schematics, technical manuals, and directives.
3. Should be able to write with clarity and technical accuracy.
4. Should be observant, alert, and inquiring with a record of excellence and stability in the performance of his duties.
5. Should be able to work with others and possess the personal desire and motivation to develop a greater knowledge of his technical speciality.
6. Should be a senior in his paygrade and in experience.

Each man designated as an inspector should receive an indoctrination on quality assurance objectives, policies, and procedures as provided in OpNav Instruction 4790.2 (Series). The indoctrination requirement is directed toward developing an appreciation for the importance and necessity of an organized quality assurance effort on a continuing basis.

TRAINING OF INSPECTORS

Training of personnel involved in quality assurance and collateral duty inspection requires continuous training in weapon system familiarization, repair procedures, trouble-shooting techniques, inspection, testing, and quality assurance considerations specifically applicable to their areas of maintenance.

Quality assurance representatives verify the adequacy and accuracy of inspections performed by the collateral duty inspectors of the work center. Collateral duty inspectors are permanently assigned to the work center and, in addition to other assigned duties, they are assigned to inspect work accomplished by other personnel within the work center. Both the representatives and the inspectors are designated in writing by the commanding officer. Only those personnel designated in writing are authorized to sign as inspectors on maintenance forms or to certify in any way that a component or equipment is ready for issue or use. A sample inspector designation form is provided in OpNav Instruction 4790.2. Copies of the form are kept in the quality assurance files and the division officer's files, with the original going in the man's service record.

QUALITY ASSURANCE AUDITS

An audit plan that encompasses all areas of work performed in the maintenance department is developed by the quality assurance officer and is utilized to audit each work center at least once quarterly. The audit plan is designed to evaluate the adequacy of technical documents, the quality of work being performed, and the validity of related maintenance and quality assurance inspection procedures.

Internally caused deficiencies are reported to the appropriate supervisor with requirements for corrective action.

Externally caused deficiencies are discussed with the work center concerned and a complete report is submitted to the maintenance officer with comments and recommendations for remedial or corrective action as required.

The person performing the audit will generally have prepared himself by having reviewed the appropriate section of the Quality Assurance chapter of OpNav Instruction 4790.2 pertaining to the purpose and goals of the audits. The inspector should have researched various work center functions and conditions so that he has the necessary information required to perform a meaningful audit.

In all probability the inspector will have reviewed such areas as:

1. The work center's compliance with the precision measuring equipment (PME) program.
2. Participation in the UR program.
3. The message board to insure that the supervisor has been reading it daily.
4. The previous audit.

Additionally he will be forearmed with the following information:

1. A list of the work center's outstanding job control numbers.
2. A list of publications checked out to the work center by the technical library.
3. A list of collateral duty inspectors assigned to the shop and the work shift to which they are assigned.

Figure 2-3 provides an example of a typical audit form utilized in one maintenance activity. The form shown is general in nature and could easily be expanded, as necessary, to include specific areas peculiar to a work center. Such areas as LOX surveillance, ejection seat indoctrination procedures for newly reporting maintenance personnel, and any other areas that may require audit attention could be added.

PLANNING FOR ADVANCED BASE OR FORWARD AREA OPERATIONS

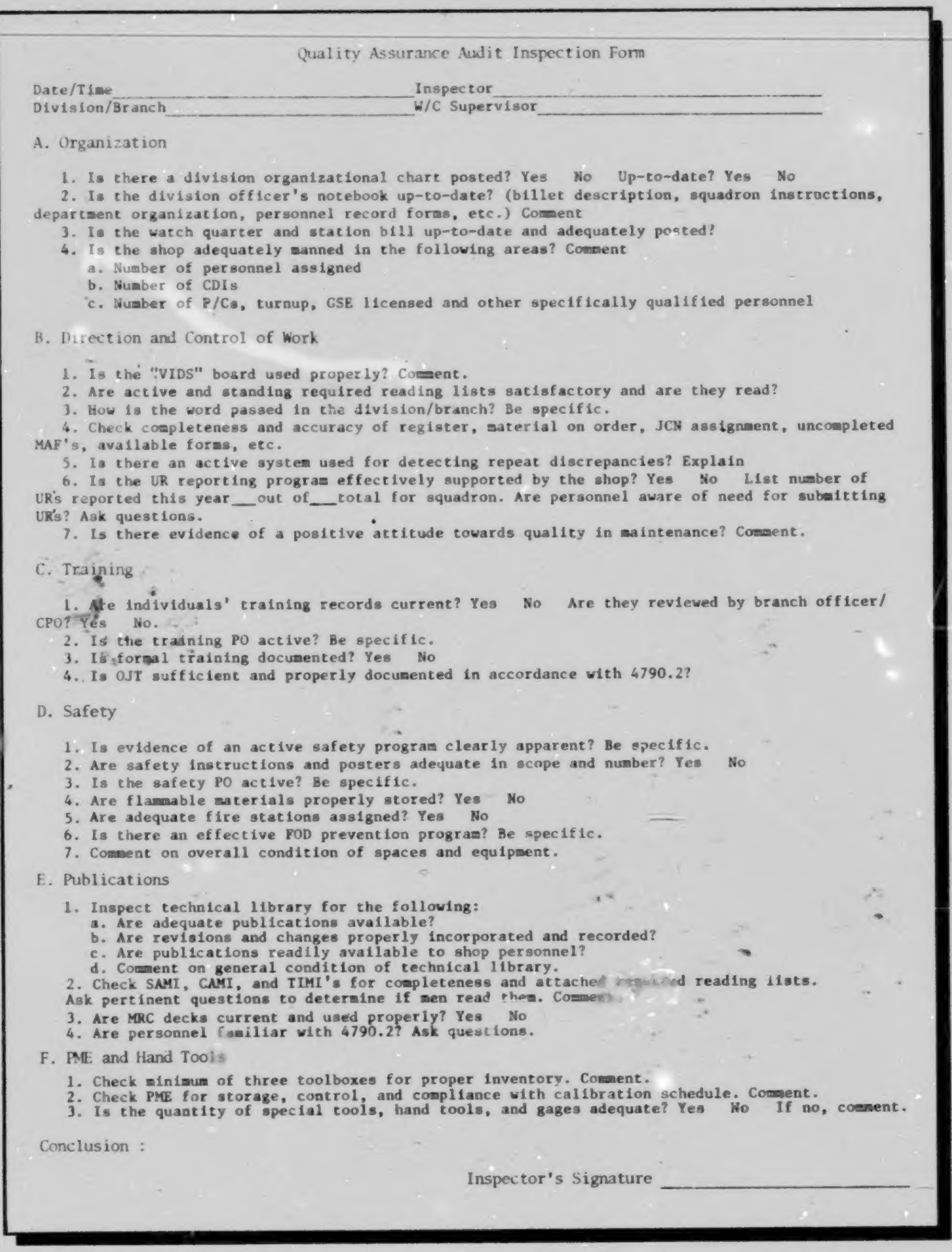
A Chief Aviation Structural Mechanic E must be able to prepare for advanced base or forward area operations by estimating aircraft spare parts and supplies, equipment, and manpower requirements for aviation structural repair. In determining requirements for forward area or advanced base operations, it is necessary to consider the following:

1. Mission.
2. Environment.
3. Operating factors.
4. The availability of existing facilities.

A knowledge of the material and manpower requirements as listed in the Advanced Base Initial Outfitting Lists of Functional Components will be very helpful. The functional component is one of more than 300 standardized units of the system which the Navy has developed to enable it to build and operate its advanced bases in the least possible time and with a minimum expenditure of planning and logistic effort.

A functional component is a list of the requirements for the performance of a specific task at an advanced base, and consists of a carefully balanced combination of material, equipment, and/or personnel.

Each functional component is classified according to its primary function into 1 of 11 major groups, including aviation. Each major grouping is identified by letter designation and title; the functional components contained in each are identified by a combination letter,



Quality Assurance Audit Inspection Form

Date/Time____________________ Inspector____________________
Division/Branch____________________ W/C Supervisor____________________

A. Organization

1. Is there a division organizational chart posted? Yes No Up-to-date? Yes No
2. Is the division officer's notebook up-to-date? (billet description, squadron instructions, department organization, personnel record forms, etc.) Comment
3. Is the watch quarter and station bill up-to-date and adequately posted?
4. Is the shop adequately manned in the following areas? Comment
   a. Number of personnel assigned
   b. Number of CDIs
   c. Number of P/Cs, turnup, GSE licensed and other specifically qualified personnel

B. Direction and Control of Work

1. Is the "VIDS" board used properly? Comment.
2. Are active and standing required reading lists satisfactory and are they read?
3. How is the word passed in the division/branch? Be specific.
4. Check completeness and accuracy of register, material on order, JCN assignment, uncompleted MAF's, available forms, etc.
5. Is there an active system used for detecting repeat discrepancies? Explain
6. Is the UR reporting program effectively supported by the shop? Yes No List number of UR's reported this year___out of___total for squadron. Are personnel aware of need for submitting UR's? Ask questions.
7. Is there evidence of a positive attitude towards quality in maintenance? Comment.

C. Training

1. Are individuals' training records current? Yes No Are they reviewed by branch officer/CPO? Yes No.
2. Is the training PO active? Be specific.
3. Is formal training documented? Yes No
4. Is OJT sufficient and properly documented in accordance with 4790.2?

D. Safety

1. Is evidence of an active safety program clearly apparent? Be specific.
2. Are safety instructions and posters adequate in scope and number? Yes No
3. Is the safety PO active? Be specific.
4. Are flammable materials properly stored? Yes No
5. Are adequate fire stations assigned? Yes No
6. Is there an effective FOD prevention program? Be specific.
7. Comment on overall condition of spaces and equipment.

E. Publications

1. Inspect technical library for the following:
   a. Are adequate publications available?
   b. Are revisions and changes properly incorporated and recorded?
   c. Are publications readily available to shop personnel?
   d. Comment on general condition of technical library.
2. Check SAMI, CAMI, and TIMI's for completeness and attached required reading lists. Ask pertinent questions to determine if men read them. Comment.
3. Are MRC decks current and used properly? Yes No
4. Are personnel familiar with 4790.2? Ask questions.

F. PME and Hand Tools

1. Check minimum of three toolboxes for proper inventory. Comment.
2. Check PME for storage, control, and compliance with calibration schedule. Comment.
3. Is the quantity of special tools, hand tools, and gages adequate? Yes No If no, comment.

Conclusion :

Inspector's Signature ____________________

AM.3

Figure 2-3.—Typical quality assurance audit inspection form.

number, and title designation. The major group letter for aviation is H.

H components are designed to provide for maintenance, support, and operation of aircraft in an advanced area under combat conditions, and may be combined with other functional components to form several types of air stations.

Complete information and data are given in the abridged and the detailed outfitting lists for functional components.

It should be apparent to the AMEC that the advanced base requirements may not be exactly as they appear in the Advanced Base Initial Outfitting Lists. In order to use these lists as guides, it will be necessary in most cases to alter or tailor them to fit the individual needs of the unit about to deploy.

Other necessary repair parts, supplies, and equipment may be determined from the outfitting and allowance lists for the aircraft or other weapon system to be supported.

It is quite likely that the AMEC will be required to advise the personnel office in making assignments of individuals to advanced base or forward area operating units. It would seem logical that the number of Aviation Structural Mechanics assigned to deploy be in the same ratio as the percentage of supported aircraft scheduled to deploy. This may be true if the proposed flight hours per aircraft of the detachment exactly equaled the planned utilization of the remaining aircraft and if there are no significant environmental problems to be overcome. The list of personnel assigned to deploy should represent a cross section of the skill levels available unless special maintenance factors indicate otherwise. The selection of personnel should be made as objectively as possible so that the deployed unit may function efficiently without working a hardship on the home group.

TRAINING OF PERSONNEL

Training of personnel is a necessary function and one of the most important responsibilities of senior Aviation Structural Mechanics. A Chief Aviation Structural Mechanic E and, to some extent, a First Class will have regular and continuing responsibilities for the training of others. Specialized skills are required to maintain and operate the complex present day weapons systems and their related test equipment.

Navy training schools, factory training, and in-service training are available for the training of maintenance personnel. The class A and B schools provide the necessary prerequisites for the specialized supplementary training provided on specific aircraft, equipment, groups of related equipment, or specialized techniques (maintenance management) by the various NAMTRADET's.

Even if a supervisor is fortunate enough to have a group of men who are highly skilled and well trained, he will find that training is still necessary. For example, the training of strikers and lower rated men for advancement examinations is a continuing, never-ending process. The Navy rotation policy being what it is, the best men will eventually be transferred and replacements will be received aboard. The replacements will, in most instances, require training before they can be relied on to take their places as effective members of the shop organization. These and similar problems require the airframes supervisor to be well versed in the several aspects of training. He must be able to set up as well as conduct an effective inservice training program for assigned personnel.

ORGANIZING THE TRAINING PROGRAM

Organizing a training program involves such considerations as planning lessons and job plans, selecting and qualifying instructors, making arrangements for classroom space, phasing the training program with the scheduled workload, procuring visual and other training aids, and determining teaching methods for each lesson or lesson series.

The subject matter areas to be included in the training program are (1) material relating to maintenance of aircraft supported, (2) general material required by the men for advancement in rating examinations, and (3) material relating to safety. In most cases lessons will fall under more than one of the subject areas.

Once it has been determined what publications will adequately cover the subject areas, the material must be divided into lessons, and lesson guides prepared. The lesson guides for each lecture are prepared in accordance with the standard format provided in OpNav Instruction 4790.2 (Series). The lectures are numbered to provide a means of recording each man's progress within his individual training folder. A training syllabus sheet, similar to the one illustrated in figure 2-4, is prepared for each man in the work center and provides a handy index to the state of training of the work center personnel as a whole.

Whether the supervisor teaches the lessons himself or assigns other petty officers to conduct them depends on the state of training of his first and second class petty officers. A requirement for advancement for third class petty officers and nonrated personnel is satisfactory completion of the correspondence course based on Military Requirements for Petty Officer 3 & 2, NavPers 10056 (Series). This text book sets forth some of the basic principles of training in general and teaching in particular.

An advancement requirement for second and first class petty officers is satisfactory completion of the correspondence course based on Military Requirements for Petty Officer 1 & C, NavPers 10057 (series). The latter text expands and amplifies training theory and introduces job analyses, training aids, and testing. For the first time in his career the prospective First Class Aviation Structural Mechanic E is required to demonstrate his ability to formally teach, use various training aids, and prepare and administer written tests. In order to demonstrate correct instructional techniques the supervisor may elect to teach certain lessons himself or assign them to a competent instructor for the same purpose. Later he may assign less proficient petty officers as instructors so that they may acquire the experience necessary for completing their practical factors for advancement.

If at all possible, training sessions should be conducted at the same time of day and on a regular schedule. Training must be scheduled to encompass all working shifts so that all personnel are included in the overall training program. Factors to consider when scheduling lessons are usual flight schedule, meal hours, watches, availability of classroom, and aircraft inspection schedule.

Some lessons are better suited for one type of instructional technique than others. The type of presentation for each lesson should be planned in advance. This will also facilitate the rotation of the lessons among the petty officers who require experience in teaching.

The effectivity of aviation technical training is greatly enhanced by the use of training aids. The supervisor should always be on the alert for scrap material that can be converted to training aids with minimum expense. He must be aware of the existence of applicable training films and, if they are available, schedule them for showing in conjunction with specific lessons. The squadron or unit safety officer or station safety engineer may usually be depended on to supply training aids in support of shop safety presentations.

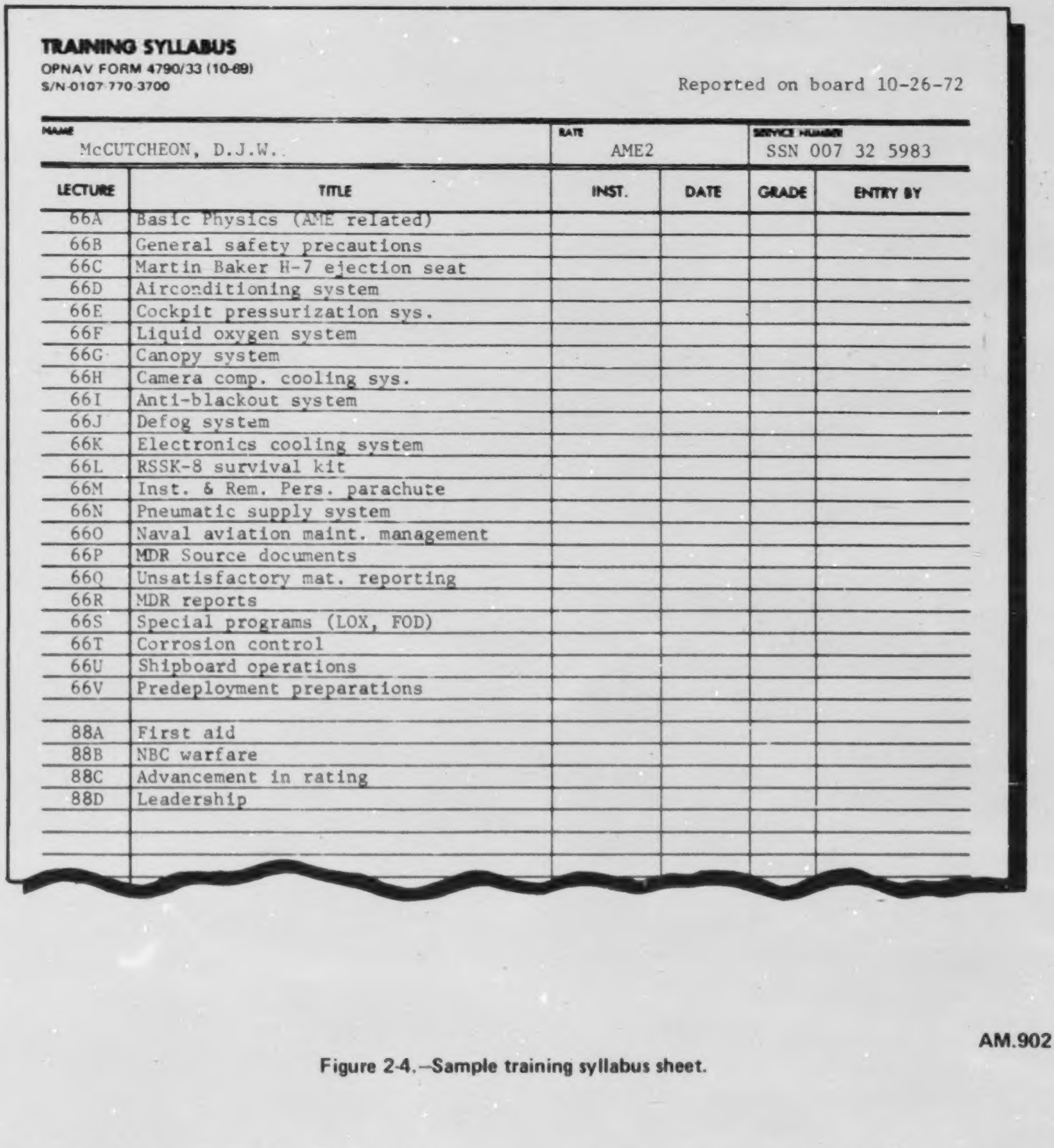
When planning a training program, the supervisor should decide where the classroom sessions should be conducted. The space selected should preferably be in a quiet area or at least one with a minimum of noisy distractions. The area should be large enough to accommodate the expected student load and be well lighted. Adequate ventilation will help keep the men awake and interested in the presentation. Convenience is another factor in the selection of classroom space. Some of the desirable space characteristics may, on occasion, have to be sacrificed in order to find a classroom nearer to the working area.

TRAINING PROCEDURES

Inservice training represents a major contribution to the Navy's overall training program. To satisfy the individual activity's particular requirements, the training program must include both lectures and practical training. In this respect, training procedures are of two general types–formal and informal.

Formal Inservice

Formal inservice training is conducted in the classroom through lectures, supplemented by required reading and implemented by the use of all available visual aids. A schedule of training is prepared and published by the maintenance administration officer. This schedule is usually prepared on a monthly basis and lists the subject of the lesson or its identifying syllabus number, the time that the training is to take place, the



TRAINING SYLLABUS
OPNAV FORM 4790/33 (10-69)
S/N-0107-770-3700

Reported on board 10-26-72

NAME	RATE	SERVICE NUMBER
McCUTCHEON, D.J.W.	AME2	SSN 007 32 5983

LECTURE	TITLE	INST.	DATE	GRADE	ENTRY BY
66A	Basic Physics (AME related)				
66B	General safety precautions				
66C	Martin Baker H-7 ejection seat				
66D	Airconditioning system				
66E	Cockpit pressurization sys.				
66F	Liquid oxygen system				
66G	Canopy system				
66H	Camera comp. cooling sys.				
66I	Anti-blackout system				
66J	Defog system				
66K	Electronics cooling system				
66L	RSSK-8 survival kit				
66M	Inst. & Rem. Pers. parachute				
66N	Pneumatic supply system				
66O	Naval aviation maint. management				
66P	MDR Source documents				
66Q	Unsatisfactory mat. reporting				
66R	MDR reports				
66S	Special programs (LOX, FOD)				
66T	Corrosion control				
66U	Shipboard operations				
66V	Predeployment preparations				
88A	First aid				
88B	NBC warfare				
88C	Advancement in rating				
88D	Leadership				

AM.902

Figure 2-4.—Sample training syllabus sheet.

location of the classroom, the names of the men who are to attend, and the name of the instructor.

Lesson guides are prepared by designated officers, petty officers, and in some cases by Contractor Engineering Technical Services/Navy Engineering Technical Services personnel. The lesson guides should contain the lecture number, title, date prepared and by whom, objectives of the lesson, time normally required in presenting the lesson, list of instructional aids, list of references with which the instructor should become familiar before teaching the lesson, outline for presentation, summary of the lesson, and questions and answers to check for understanding.

When a petty officer has been assigned to instruct a given lesson, it is his responsibility to procure a copy of the lesson guide and from it prepare his personalized lesson plan. Since lesson plans are prepared by the individual instructor, they may differ slightly from instructor to instructor. They must cover the information outlined in the lesson guide. The quality of the lesson given will reflect the amount of preparation given by the instructor plus his experience and ability to instruct.

Informal Inservice

Informal training is the practical instruction of men in the performance of maintenance tasks by means of demonstration and imitation under personal supervision in the shop or on the operating line. Nearly every maintenance task that is undertaken presents an opportunity for on-the-job training. The experienced men of the work center are utilized as fully as possible in demonstrating and imparting their skills to the less experienced.

Under this system, the trainee has the opportunity to actually do the job under the supervision of an experienced petty officer. The only equipment necessary is the job itself. It is necessary, of course, that the instructor have an interest in the job and the skill to do it well. The striker or trainee will learn by seeing the job performed, and he will gain experience by having a chance to participate in the accomplishment of the job.

The nature of informal training makes regular scheduling impracticable. Actually, it is done at every opportunity. A training syllabus is prepared under the guidance of the maintenance officer, with content and scope corresponding with practical factor requirements of the personnel. The degree of success in on-the-job training (OJT) depends on the degree of recognition by each individual of his responsibility to his outfit to impart his skill and knowledge to the man who is trying to learn.

TRAINING DOCUMENTATION AND RECORDKEEPING

Maintenance activities that are directed to account for production manhours should comply with the manhour accounting procedures outlined in OpNav Instruction 4790.2 by submitting manhour accounting cards to reflect the accomplishment of formal inservice training. Procedures for submitting manhour accounting cards are provided in Military Requirements for Petty Officer 3 & 2, NavPers 10056 (Series), and OpNav Instruction 4790.2.

The individual Training Syllabus Sheet provides a record of formal lectures attended by each man in the work center. A report of practical training (OJT) should be made to the division officer at regular intervals. This will indicate to the division officer that a man has fulfilled a satisfactory level of skill to justify completing of the various items listed on the individual's practical factors for advancement sheet. The formal training syllabus record and the record of practical training will indicate that required training has been completed in all areas or that a need for special training exists and further certifies when the individual may be considered qualified for advancement.

MAINTENANCE SAFETY

The Chief of Naval Operations at the direction of the Secretary of the Navy is assigned the responsibility for implementation, direction, and supervision of the Department of the Navy Safety Program. This assignment was made to coordinate the effort and provide positive overall supervision through the chain of command. In this respect, safety becomes an inherent responsibility of command. Command implementation comprises those functions associated with command in carrying out safety policies and directives, and in amplifying safety guidance where necessary. The objective of the safety program is to establish an effective, aggressive, and continuous accident prevention program with the goal of enhancing operational readiness by reducing deaths and injuries to personnel as well as losses and damage to all Navy material from accidental causes.

AVIATION SAFETY PROGRAM

The activity safety officer is required to provide safety education throughout the command as well as to insure that safety standards and procedures are incorporated into all activity functions. Other equally important tasks include translating data concerning accidents and mishaps into useful and meaningful information for activity use, monitoring the existing environment for hazard potential, and keeping the activity advised in matters concerning safety and accident free operations.

The key to this program as with many other programs is effective communications at all levels of command. A variety of publications are afforded to the safety officer and key members in the safety program. The Naval Safety Center helps to promote safety in aviation and other areas of operation through various safety oriented publications. Most of the publications are automatically distributed to aviation squadrons, ships, staffs, and shore activities. Each publication is intended for a primary audience but, in general, can be useful source material for a complete safety program. A brief introduction to these publications is provided in the following paragraphs.

APPROACH MAGAZINE, the Naval Aviation Safety Review, is published monthly for the benefit of all levels of naval aviation. It contains articles on flight operations, flight surgeons' notes, maintenance commentaries, and short features with the purpose of presenting the most accurate information currently available on the subject of aviation accident prevention.

MECH, the Naval Aviation Maintenance Safety Review, is published quarterly and is directed at the enlisted aviation maintenance personnel. It presents the most accurate information available on maintenance-caused mishap prevention and general aviation ground safety directed at reducing maintenance errors and handling mishaps. Contents of MECH are intended to be informational and should not be considered as orders, regulations, or directives.

FATHOM is published quarterly and is of special interest to submariners and surface ship personnel. It does contain material of interest to all hands such as articles of general educational interest to all hands such as articles of general educational interest, statistics on accidents and incidents, and provides recommendations for improving shipboard safety.

WEEKLY SUMMARY OF MAJOR AIRCRAFT ACCIDENTS contains safety discussions, accident briefs, statistics, and safety tips. It is provided primarily for command considerations.

SHIPS SAFETY BULLETIN is a monthly publication and is the counterpart of the Weekly Summary of Major Aircraft Accidents. It contains articles on current shipboard safety problems, trends, accident briefs, and statistics pertaining to ships safety.

EMERGENCY AIRBORNE ESCAPE SUMMARY is published annually to provide commands, operators, and other interested agencies with data compiled on ejections, bailouts, and ditchings of Navy and Marine aircraft.

LIFELINE, the Navy safety journal is published bimonthly. This publication emphasizes the human factors in accident prevention, occupational health and safety, industrial and fire safety, and safety and survival equipment. It presents the most accurate information currently available on the subject of environmental and occupational safety and is one of the means by which the Naval Safety Center provides the Navy with educational material necessary for pursuing a vigorous and effective command safety program.

The Safety Center also provides posters featuring the various aspects of operations at sea, in aviation, and ashore. They are available on request from the NavSafCen. Articles for these publications are submitted by fleet activities and training commands. Personnel with safety related experiences that might benefit others should pass it along to the safety center for consideration. Most of these publications are intended for more than one reader, and the information contained in them should be appropriately disseminated.

The safety program established at the maintenance department/division level must be a primary concern of all hands. It requires active participation by all personnel on a day-to-day basis to obtain the desired results. The quality assurance division is assigned overall responsibility for the safety program at this level and establishes a coordinating group to assist in implementing the total safety plan of the activity. The quality assurance plan for the activity includes the safety program requirements. Lower level directives are prepared as necessary to insure proper implementation throughout the department/division. Items given attention in the maintenance safety program include, but are not limited to, the following:

1. Dissemination of appropriate safety posters and literature.

2. Reporting of all accidents, incidents, and unsafe practices in the department.

3. Conducting of safety meetings within the department/division. The minutes of these meetings and pertinent agenda items should be published and made available to the maintenance supervisors concerned.

4. Participation in activity safety surveys as may be required by higher authority. Safety Review Checklists are available from the Naval Safety Center as an aid for conducting safety surveys.

Effectiveness and safety result from properly trained personnel using properly designed equipment in accordance with established procedures under competent and persistent supervision.

Aircraft maintenance is, to some extent, naturally hazardous due to the nature of the work, the equipment and tools involved, and the variety of materials required to perform many repairs and maintenance functions. Factors which can function to increase or decrease these hazards include the following:

1. The experience levels and mental attitudes of assigned personnel.

2. Tempo of operations combined with haste and inattentiveness.

3. Unnecessary risk or disregard of common safety practices.

4. Disregard or unawareness of technical and safety directives.

5. The quality or lack of supervision of the maintenance tasks.

6. The adequacy of indoctrination of all personnel regarding the potential hazards within the work area.

The primary function of naval aviation maintenance personnel is that of keeping aircraft in top operating condition with a resultant high degree of readiness for prompt and sustained combat operations. Temporary or permanent loss of personnel or equipment directly affects the combat readiness of the activity concerned.

Accident prevention is affected more by the quality of professional competence demonstrated by key individuals than by any other consideration. The close personal attention of maintenance supervisors is required.

The concept of aircraft maintenance safety should extend beyond concern for injury to personnel and damage to equipment and aircraft. Safe work habits go hand-in-hand with flying safety. Tools left in aircraft, improper torquing of fasteners, and poor housekeeping around aircraft can cause conditions which may claim the lives of flying personnel as well as cause strike damage to aircraft. Safety on the ground is equally as important as safety in the air.

A recent type commander letter states in part, "While the increased complexity of our modern aircraft is a factor, it is noted that a large number of maintenance-error-caused accidents and incidents are due, not to complexity of equipment, but to lack of supervision and technical knowledge. Many mistakes are simple ones in routine maintenance."

Safety in aircraft maintenance depends largely upon the supervisory personnel. The standards of quality which they establish are directly reflected in the quality of the aircraft maintenance. The primary duty of the senior petty officers is to supervise and instruct others rather than to become totally engrossed in actual production. Attempts to perform both functions invariably result in inadequate supervision and greater chance of error. Supervisors must exercise mature judgment when assigning personnel to maintenance jobs. Consideration must be given to each man's experience, training, and ability.

Sometimes overlooked in a maintenance program are the considerations generally grouped under the term "human factors." These factors are important in that they determine if an individual is ready and physically able to do work safely and with quality. Supervisory personnel should be constantly aware of conditions such as general health, physical and mental fatigue, unit and individual morale, training and experience levels of personnel, and other conditions which can contribute in varying degrees to unsafe work. Not only is it important that proper tools and protective clothing and equipment are available for use, but also the insistence by maintenance supervisors that they are used is of increasing importance with modern high performance aircraft. For example, maintenance personnel are sometimes negligent in the wearing of protective hearing devices in high noise areas.

Technical knowledge also plays a large part in a good maintenance safety program. The complexity of our modern equipment demands the attention of well-informed and expert maintenance personnel; otherwise, our weapons systems cannot be operated and maintained. Technical knowledge is a function of education and training which, incidentally, does not end with graduation from Class A school. Graduation is only the beginning. Any AME worthy of the rating is continually training and learning through self-study and application and through a personal desire for proficiency and self-betterment. But technical knowledge by itself is not sufficient unless it is coupled with an old-fashioned craftsmanship that receives gratification and keen satisfaction in doing any job well. The AME who wishes to contribute to safety and reliability improvement must know his job and must develop professional pride in the quality of his work.

It is a continuing duty of every person connected with aircraft maintenance to try to discover and eliminate unsafe work practices. Accidents which are caused by such practices may not take place until a much later date and their severity cannot be predicted. The consequences may range from simple material failure to a major accident resulting in serious injuries or fatalities.

There are several areas in which the supervisor can effectively work to minimize accidents incident to aircraft maintenance. The organization and administration of an active and continuous program of accident prevention with provisions for inspection of work areas, tools, and equipment; correct interpretation and dissemination of safety directives and precautions; and energetic and imaginative enforcement of them are all important.

ORGANIZATION AND ADMINISTRATION OF AN ACTIVE PROGRAM

It is the responsibility of all supervisory personnel to insure that their subordinates are instructed in and carry out the applicable safety precautions for their area of work. Each individual is held responsible for knowing, understanding, and observing all safety precautions applicable to their work and work areas. The individual is additionally charged with the following responsibilities:

1. The individual should report to work reasonably rested and emotionally prepared to perform the tasks at hand.
2. He should exercise normal prudence in all his functions, commensurate with the work at hand.
3. He should report all unsafe conditions regarding equipment and materials and any unusual or developing hazards to his immediate supervisor for appropriate action.
4. He should warn others whom he believes to be endangered by known or potential hazards and of their failure to observe safety precautions.
5. He should report to his supervisor any accident, incident, injury, or evidence of potential hazard occurring in the course of work.
6. He should wear or use the protective clothing and/or equipment of the type approved, required, and provided for the safe performance of his work.
7. He should report for work suitably attired for his assigned tasks. For example, wear eye correction, hearing aid, foot protection, style of clothing, hair style, beard, etc., as applicable, that would not present a hazard.

The safety program must be in accordance with local instructions and instructions provided in OpNav Instruction 4790.2 for the maintenance department/division safety program. The Navy Aircraft Accident, Incident, and Ground Accident Reporting Procedures provided in OpNav Instruction 3750.6 (Series) require maintenance personnel participation in investigating, reporting, and preventing aircraft accidents/incidents.

NavMat Publication P-5100, Safety Precautions for Shore Activities, contains precautions that cover almost all aspects of maintenance safety that are to be implemented by maintenance personnel. Mandatory precautions in this manual are characterized by use of the words shall, must, and prohibited. Recommended or advisory precautions are indicated by use of the words should, will, and may. The precautions are of necessity basic and general in nature and are not inclusive of all conceivable operations and functions involved in the large variety of Navy day-to-day activities. Reference is made from time to time to other publications for detailed safety information applicable to a specific condition or hazard. A lack of documented hazard with accompanying precautions is not an indication of their nonexistence or unimportance. Maintenance personnel must display continuous cooperation and vigilance in seeing that all operating procedures and work methods do not unnecessarily expose personnel to injury or property to loss or damage.

The NATOPS program provides complete and detailed guidance on procedures and precautions to be followed when operating naval aircraft. General guidance of concern to supervising petty officers may be found in the NATOPS Manual General Flight and Operating Instructions, and the CVA/CVS NATOPS Manual. Ground and flight procedures for individual aircraft are contained in the NATOPS Manual for each specific aircraft.

The ground procedures will in most cases parallel those found in the General Information and Servicing volume of the Maintenance Instructions Manual for the specific aircraft concerned.

Instructions in appropriate safety precautions are required to be given and positive action must be taken in the case of willful violations.

The safety program will generally involve three areas of attention–the posting of the most important safety precautions in appropriate places, the incorporation of safety lessons in the formal training program, and frequent checks for understanding and compliance during the day-to-day supervision of work.

Fixed posters and signs must be placed in locations where personnel are most likely to see them and where they will provide the maximum impact. They should be relevant to activities engaged in by personnel located in the space where they are displayed and removed or rotated to enhance their effectiveness. Visual information should be presented in a positive manner so that it will impart appropriate precautionary measures without instilling fear. Appropriate safety posters may be obtained from the activity safety officer.

Posted safety precautions are more effective if they are easily complied with. For example, a sign on a tool grinder reads "goggles required," so one or more pairs of safety goggles should be hanging within reach at the machine. Similarly, the protective clothing poster in the AME work center should be backed up with readily available coveralls, gloves, shields, etc.

The formal safety training sessions should utilize films, books, visual aids, or any other suitable technical material. The men should be told more than just what or what not to do. Each safety subject should be explained in detail. The results of unsafe acts are usually the most dramatic and easiest remembered. Causes of accidents and contributing factors should be reviewed and analyzed. Many good ideas for accident prevention have been developed in training sessions.

An extensive series of lessons may be developed over a period of time as latent hazards are recognized, and this will aid in keeping the sessions interesting while avoiding too frequent repetition.

It may be well to mention the new man in the work center at this point. A separate safety indoctrination lesson which covers all the major hazards of the work center should be given the new man as soon as he reports for work. No supervisor with an effective safety program and an excellent work center safety record wants to take the chance that the new man will be injured before attending the complete series of safety lessons.

In the third area of safety program administration–followup–the supervisor will have one or more key members of the work center who attend the quality assurance safety meetings. These members will provide inputs regarding safety violations and potential hazards that should be advertised and disseminate information discussed during meetings to all personnel in their respective work area. These members as well as supervisors provide a definitive communication link in pointing out peculiar activity hazards and current violations and can take immediate action to remedy such situations. Subordinate petty officers must assist in monitoring the program on a continuous basis. Also included in the followup area is a responsibility of the supervisor to inquire as quickly and thoroughly as possible into circumstances of accidents and reports of unsafe practices and the taking of action and/or making of recommendations.

Interpretation of Safety Directives and Precautions

The safety precautions contained in Safety Precautions for Shore Activities are designed to cover usual conditions ashore. Commanding officers and others in authority are authorized to issue special precautions to their commands to cover local conditions and unusual circumstances. The supervisor will have to apply both sets of rules in the administration of his work center safety program.

Safety directives and precautions should be followed to the letter in their specific application. Should any occasion arise in which any doubt exists as to the application of a particular directive or precaution, the measures to be taken are those which will achieve maximum safety.

When new safety posters or precautions are posted, it is the responsibility of the supervisor to correctly interpret their application to his men. In this way he will be able to achieve a unity of thought and action in the observance of the required safety rule.

The organization's safety officer is available to assist in interpreting and suggesting ways of implementing various safety directives and precautions. Current directives require that a safety officer or safety engineer be assigned as head of the safety department, division, branch, or section, whichever is applicable, at all shore stations.

In most instances the hazards involved and the applicable precautions for a given type of work are the same whether the work is done afloat or ashore. However, the safety program must account for inherent dangers and provide precautions necessary for afloat operations that are not present ashore. An example of this would be a hazard peculiar to flight deck operations.

Inspection of Work Areas, Tools, and Equipment

Most accidents which occur in noncombat operations can be prevented if the full cooperation of personnel is gained and vigilance is exercised to eliminate unsafe acts. The airframes supervisor should diligently inspect work areas, tools, and equipment to detect potentially hazardous and unsafe conditions and take appropriate corrective action. The AME may be working in the shop, in the hangar, or on the line, and all these areas should be included in the supervisor's inspection. He should check for explosion or inhalation hazards due to improper ventilation of working spaces, or careless handling of materials.

Fire hazards present another serious problem. "No Smoking" rules should be strictly enforced. Ground wires should be installed on every aircraft during maintenance to eliminate dangerous static electrical buildups. Spilled oil, grease, and chemicals should be wiped up promptly, and all rags used should be disposed of in covered metal containers.

Handtools should be in good shape, of the proper type, and used only for the purpose for which they were designed.

Insure that equipment is operated only by qualified personnel, and that all safety devices and guards are installed and in good condition. The equipment should also be inspected for broken or damaged components. Check to see that periodic maintenance, servicing, and/or calibration are up-to-date for those equipments requiring it. Details on the Air Systems Command Calibration Program and amplifying information on other selected programs are provided in OpNav Instruction 4790.2.

Weapons System Emergency Procedures

As previously stated, safety precautions peculiar to a specific aircraft are covered to a large extent in the General Information volume of the Maintenance Instructions Manual for that aircraft. The emergency procedures section of this manual is a most useful aid when producing safety training lectures for formal presentation.

While it pertains primarily to line personnel, crash rescue personnel, and plane captains, the information could prove invaluable for that moment when a tailpipe fire, brake fire, nose gear collapse, or similar incident occurs in the absence of personnel trained to handle such emergencies and immediate action is required. As the senior person present, you would be expected to take charge and initiate this action.

The warnings and precautions dispersed throughout the various maintenance manuals and included in most other directives must be adhered to. Changes or revisions to manuals should be screened upon receipt for new procedures, warnings, precautions, etc., that may affect your area of work and that may require amplification or clarification.

A qualified AME should also give all maintenance personnel an indoctrination regarding the hazards associated with the aircraft's ejection seats, canopy operation, and any other hazards associated with occupancy of the cockpit.

Ship Predeployment Indoctrination

Many times in the past, squadrons, well prepared concerning hazards associated with operating aircraft ashore, deployed to a ship with little or no indoctrination being provided with regard to the shipboard operating environment.

The work center supervisor should insure that such indoctrination is accomplished well in advance of any personnel going to the ship for carrier qualification or extended deployments. The following paragraphs provide coverage on areas that have frequently been neglected.

Personnel should learn several ways to proceed from work spaces, berthing compartments, and messing compartments to a weather deck or source of fresh air. During fires and subsequent damage control procedures, personnel could encounter heavy smoke concentrations and complete darkness. Failure to know at least one or more escape routes that can be executed in the dark could be fatal.

When the ship is underway, personnel who are not specifically required to be on the flight deck must stay off it. When air operations are in progress, personnel required on the flight deck must be in a complete flight deck uniform. A complete uniform consists of an appropriate colored, long sleeve jersey and safety clamshell helmet, life vest, survival flashlight and whistle, flight deck/safety toe shoes, and when feasible, gloves. The survival flashlight should be checked daily and the life vest inflated at least once a week (orally) to check for leakage.

Personnel should be familiar with the various ship conditions and drill procedures and participate to the maximum extent authorized. During General Quarters (GQ) personnel should proceed to their assigned station at a fast pace; however, running is not recommended because of the possibility of striking hatch combings, knocking down of other personnel, and other hazards related to excessive speed.

All personnel in the activity must undergo refresher shipboard firefighting courses prior to deployment.

New personnel reporting to an activity already deployed should be given an indoctrination immediately. Such personnel become easily confused when attempting to find their way and are very prone to wandering where they do not belong. Allow one of the man's new shipmates to show him around so that he may become acquainted with his new surroundings in a safe manner.

CHAPTER 3

AVIATION SUPPLY

A Chief or First Class Aviation Structural Mechanic E, especially if in a supervisory billet, will find himself increasingly involved in the details of supporting the man on the job. One of these areas is in the field of aviation supply.

Aviation supply personnel are vital members of the aircraft maintenance team; and the AME, as well as personnel in the other aviation maintenance ratings, must work in close harmony with them if successful teamwork is to be achieved. The team must work so that a flow of parts is maintained from the manufacturer to the man on the job—quite possibly an AME doing repair work on the other side of the world. A correct concept of supply's relationship to the entire organization is essential in the supervision of aircraft maintenance functions.

ORGANIZATION AND FUNCTION OF NAVAL SUPPLY

The command exercising management control over the policies and procedures of the aviation supply organization is the Naval Supply Systems Command. The Commander, Naval Supply Systems Command is usually a rear admiral who is appointed by the President with the advice and consent of the Senate. He works with the delegated authority of the Secretary of the Navy, and all policies and procedures of the aviation supply organization emanating from him have the full force and effect of SecNav orders.

To better understand the relationship of the Naval Supply Systems Command to the aviation supply system, it might be well to quickly review the development of the Navy supply system.

Prior to 1842 the commanding officers of ships and stations were responsible for the procurement of their own supplies. They were furnished funds for this purpose by the Navy Department and were required to account for all expenditures. In addition to creating an intolerable burden of paperwork on the Navy Department, this procedure had the effect of forcing prices upward, especially when two commanding officers were bidding for some scarce commodity.

In 1842 Congress approved the establishment of a Bureau of the Navy to take cognizance over all matters of naval supply. The primary responsibilities of this infant supply bureau were the procurement, maintenance of custody, and issuance of naval material. They are the primary responsibilities of the Naval Supply Systems Command today. Every function of the Naval Supply Systems Command is directly related to one or more of these responsibility areas.

In the early years of naval aviation when the Navy had few aircraft, the procurement of spare parts was much like the old system whereby commanding officers dealt directly with the sellers to fill the needs of each command. The pioneer naval aviation project directors had to deal directly with the manufacturers as parts were required.

By 1917 the Naval Aircraft Factory (NAF) in Philadelphia had come into existence and was assigned responsibility for the procuring of aircraft and spare parts. Other responsibilities assumed by NAF included the repair of aircraft, the manufacture of some spare parts, and eventually the manufacture of complete aircraft. There may still be a few aviators around today who earned their Navy wings in the old N3N, built by NAF.

In 1921 the Bureau of Aeronautics (Bu Aer) came into being and assumed the responsibility of procuring aircraft and aircraft engines. The responsibility for procuring spare parts and other aeronautical material remained with NAF, which until 1941 was the aviation supply center of the Navy.

The Aviation Supply Office (ASO) was established in 1941 under the technical control of BuAer and the management control of the Bureau of Supplies and Accounts. The function of ASO was the procurement, custody, and issuance of aeronautical spare parts and technical material. This is essentially the function of ASO today under the technical control of the Naval Air Systems Command. Management control of ASO is exercised by the Naval Supply Systems Command.

RESPONSIBILITIES OF THE NAVAL SUPPLY SYSTEMS COMMAND

The general functions of the Naval Supply Systems Command include many that are not related to aircraft maintenance, and not of primary interest to AM personnel. Listed below are some of the more important general functions of the Naval Supply Systems Command:

1. Supervises the procurement, receipt, custody, warehousing, and issuance of Navy supplies and materials, exclusive of ammunition, projectiles, mines, explosives, and medical supplies.

2. Supervises and directs the operation of the supply phases of the Navy supply system and administers the redistribution program of excess personal property within the Department of Defense and the sale of Navy surplus property.

3. Authorizes and supervises the transportation of Navy property.

4. Prepares budget estimates and administers funds for the supply distribution system.

5. Renders an annual report to the Congress of money value of supplies on hand at the various stations at the beginning of each fiscal year, the disposition thereof, purchase and expenditure of supplies for the year, and balance on hand.

6. Coordinates the compilation and arranges for the printing of the Catalogs of Navy Material.

Some additional functions of the Navy Supply Systems Command that are of interest to AM personnel are the general functions of ASO. These include the following:

1. Responsibility for overall determination of requirements, procurement, and distribution of standard aeronautical materials. (Certain materials excepted; such as complete aircraft and engines, complete electronic equipment, major photo equipment, nonstandard and experimental aerological equipment, and items of naval weapons ordnance equipment.)

2. Maintenance of a complete file of ASO and Naval Air Systems Command contracts, letters of intent, amendments, extensions, and change orders, and distribution of all necessary copies of documents to Navy field activities.

3. Stock control of aeronautical materials at all aviation supply facilities, including control of packing, preservation and distribution of material under ASO cognizance to, from, and between aviation supply facilities and major supply points.

4. Maintenance of complete records of material on order and followup procedure necessary to effect timely deliveries for all material under ASO cognizance.

5. Maintenance of up-to-date records of existing storage facilities at depots, major supply points, and operating stations for aeronautical materials, and control of influx of materials in aviation supply channels so as not to exceed existing storage facilities.

6. Determination and disposition of obsolete and excess aeronautical material under NavAirSysCom cognizance.

7. Preparation and distribution of the Navy Stock List of ASO, including interchangeability data.

8. Compilation and distribution of some allowance lists subject to approval by NavAirSysCom.

9. Compilation of lists of spare parts to be salvaged from surveyed aircraft.

10. Followup on delivery, stock recording, reallocating as necessary, and distributing change material promulgated by NavAirSysCom.

11. Establishment and maintenance of a statistical unit which assembles, compiles, and analyzes usage data.

12. Maintenance of a representative at each aircraft manufacturer's plant who keeps ASO fully informed, as requested, as to all changes which affect spare parts under procurement.

13. Establishment of an inspection service which inspects aviation supply activities within established naval districts.

APPROPRIATIONS

At one time or another, almost everyone has had the frustrating experience of not being able to draw from supply some item needed immediately; the usual reason given being, "we do not have any money left." It takes only a short time to realize that the Navy does not operate with unlimited funds. This section and the following section, titled, "Operating Budgets," are presented to further an understanding of the system whereby funds are made available at the user activity level for operating expenses.

The main money pool of the government is the General Fund of the Treasury. Funds come into the General Fund from such sources as income taxes, excise taxes, import-export taxes, etc. The only way for money to be expended from the General Fund is by congressional action, which has to be approved by the President. A bill passed by Congress which includes the expenditure of funds from the General Fund is called an appropriation.

An estimate of the amount of money required for the operation of the Defense Department during a given fiscal year is prepared by Department of Defense fiscal experts well in advance of the beginning of the fiscal year. The Congress studies the proposed budget in the light of world affairs, the current domestic economy, and such other considerations as they see fit, then acts upon it. Congress may increase the amount requested, decrease it, or pass it as is. After presidential action is completed, the money is made available to the Department of Defense to be spent during a specified year. This is known as an "annual" or "one-year" appropriation.

Congress and the President may also approve "no-year" appropriations for special projects such as large construction programs over an unspecified length of time.

Another form of appropriation is the "multiple-year" appropriation for projects which will be completed in a predictable length of time. An example of the use of this type of appropriation is the money appropriated to cover the expenses of the NROTC college program for the next 4 years.

The appropriation by which the AM is most affected is the "current-year" appropriation. After the appropriation or expenditure authorization is received in the Department of Defense, it is prorated among the services as a percentage of their previously submitted budget estimates. The Navy's share is prorated among the various systems commands and bureaus in essentially the same manner; that is, as a percentage of their estimated requirements for the coming fiscal year. The money to be spent for naval aviation is made available to NavAirSysCom. Here, part of the money is allocated to ASO for the purchase of aircraft spare parts and related equipment in quantities which past usage data has indicated will probably be sufficient for the coming year. These spare parts are furnished to the operating activities at no cost, since their usage has been anticipated and the items paid for in advance. The account from which money was spent to buy these items is known as the Appropriation Purchase Account (APA). Material received in the user activities from this account is known as APA material.

Another part of NavAirSysCom funds is made available to the operating activities in the form of operating budgets.

OPERATING BUDGETS

Funds available within an appropriation account for commitments, obligations, and expenditures are administered through the issuance of operating budgets; An approved operating budget is an authorization granted for the purpose of incurring commitments, obligations, and expenditures to accomplish the mission of an activity. Therefore, an approved operating budget is a subdivision of an appropriation which provides the funding authority for an official to accomplish a specific function or mission.

Approved operating budgets concerning naval aviation are authorizations by NavAirSysCom to the user activities to spend a certain amount of money during a given length of time for specified purposes. User activities are shore commands, which operate aircraft, and the major air type commanders.

Operating funds for stations, rework activities, etc., concerned with the operation and maintenance of aircraft and related equipment are allotted to them by the NavAirSysCom as an operating budget. Departments within these organizations normally submit their department budget to the station comptroller who reviews and combines the different department budgets into a recommended station budget. Senior AM's may be called upon to assist in furnishing a realistic estimate of division operating expenses and future needs which the department head may use in formulating the department budget.

Since there is a relatively long period between budget submission and the subsequent receipt of funds, the necessity of accurate estimates of future requirements and strict management of materials for which allotted funds are expended cannot be overemphasized.

Operating funds for squadrons and units are apportioned to them by their type commander as an Operating Target (OPTAR). Routine nonaviation expenses for operating squadrons and units are absorbed by the ship or station to which assigned.

Operating Targets

Funds to finance the operation of aircraft are allotted by the NavAirSysCom to the air type commanders. Operating funds for squadrons and units are apportioned to them by their cognizant air type commander as an operating target (OPTAR). An OPTAR is a planned estimate which the air type commander allocates for the financing of aircraft operating costs during a given period of time. OPTAR's are issued on a quarterly basis and unused funds from the previously issued OPTAR revert to the control of the type commander as each new OPTAR is authorized. Type commanders provide OPTAR's to squadrons, units, and ships under their operational control, whether or not the user activity is based ashore.

There are several different types of OPTAR's issued by air type commanders for aviation purposes. Two that are of interest to AM personnel are FLIGHT OPERATIONS and AIRCRAFT MAINTENANCE FUNDS. These are discussed in the following paragraphs.

Flight operation funds are used primarily for the purpose of financing actual flight operations therefore, they have application at the Organizational level. These funds finance the following:

1. Aviation fuels and lubricants consumed in aircraft.
2. Liquid and gaseous breathing oxygen and nitrogen.
3. Aerial film for use in aircraft cameras.
4. Flight clothing and operational equipment authorized in NavAirSysCom Allowance List (NavAir 00-35QH-2).
5. Flight deck/safety shoes.
6. Squadron administrative consumable office supplies.
7. Unit identification marks (shoulder patches) for initial issue to newly reported personnel.
8. Material and services required when located at an activity without Navy or Marine Corps Intermediate maintenance capability.

Aircraft maintenance funds are provided to Organizational and Intermediate maintenance activities to finance the cost of various supplies and materials consumed in the performance of aviation maintenance. These funds finance the following:

1. Repair parts, common hardware, lubricants, cleaning agents, cutting compounds, metals, and other materials incorporated into or expended in the performance of aviation maintenance of aircraft, engines, aeronautical components and subassemblies, and Navy maintenance of aviation maintenance support equipment.
2. Fuels and lubricants consumed by aircraft engines in the performance of complete section repairs.
3. Pre-expended, consumable maintenance materials.

4. Replacement of expendable or consumable allowance list items with material accountability codes B and C. (Allowance list and material accountability codes are discussed later in this chapter.)

MATERIAL IDENTIFICATION

In addition to the task of supervising lower rated AM personnel in the performance of routine duties, senior AM's may be assigned maintenance supervisor duties. In some cases, these duties will encompass the task of assisting in the procurement of material and parts used by production personnel. One important area of material procurement is the correct identification of the material and parts required. It is important that senior AM's be familiar with some of the methods of identifying material.

There may be times when a part or some technical material is needed and the stock number is unknown. At other times some material may be on hand and its identity not positively known. A knowledge of the various methods of identifying material other than by stock number will often help speed the completion of a maintenance task. Certain data may be available which do not identify an item but which may lead to positive identification. The following sections discuss some methods of identifying material.

FEDERAL STOCK NUMBERING SYSTEM

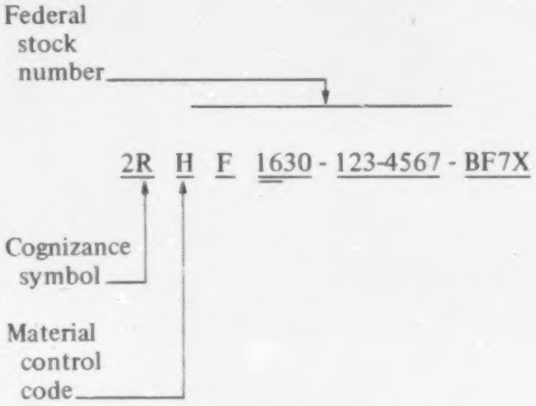
The Defense Cataloging Standardization Act, passed by Congress in 1952, provided for a uniform system of identification, classification, and stock numbering throughout the Department of Defense. Prior to this time there were many stock numbering systems within the Department of Defense and within the Navy itself. It was possible for the same item to be stocked under different stock numbers as Navy general stores, Navy aviation stores, Army quartermaster stores, Army ordnance stores, Air Force stores, and many others. This caused duplication and waste. There was no cross-reference system whereby an agency could determine if its excess material was the same as that which was in short supply in another agency.

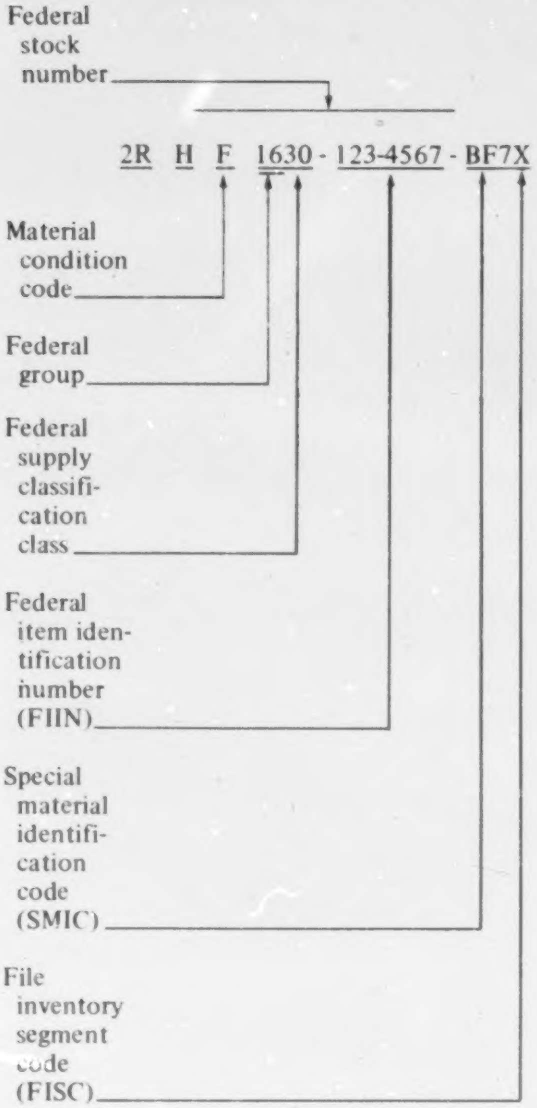
The federal cataloging system eliminated this situation by placing all like items under a federal stock number bearing a common official government name. This system was made applicable to all agencies within the Department of Defense.

Under the federal cataloging system, federal stock numbers are required for all items that are subject to central inventory management within the Department of Defense. Each Navy item to be stocked under centralized inventory control is assigned a federal stock number which is used in all supply management functions. This FSN is listed in all supply publications in which the item is referenced.

CODED FEDERAL STOCK NUMBER

The federal stock number is an 11-digit number, which furnishes positive identification of virtually all items of supply from purchase to final disposition. In addition to the 11-digit number, the Navy supply system utilizes certain code prefixes and suffixes to aid in the performance of various management functions. These codes are of significance only within the Navy and are not used during interservice transactions. The following example describes the format of a coded federal stock number for an item of supply under the cognizance of the Aviation Supply Office:




Federal stock number
2R H F 1630 - 123-4567 - BF7X
Material condition code
Federal group
Federal supply classification class
Federal item identification number (FIIN)
Special material identification code (SMIC)
File inventory segment code (FISC)

Cognizance Symbol

A cognizance symbol consists of a 2-character code prefixed to a federal stock number to identify and designate the systems command, office, agency, or Navy inventory manager that exercises management control over specific categories of material. The first digit of the cognizance symbol also conveys certain accounting information to the supply system. Generally, odd numbers indicate that the material is carried in the Navy Stock Account (NSA), while even numbers indicate that it is carried in the Appropriation Purchase Account (APA).

The Navy Stock Account is an inventory account and integral part of the Navy Stock Fund. This fund exists to provide the necessary capital to finance the purchase of material used by the navy. Requisitions for NSA type materials are charged against the activities OPTAR's and credited to the Navy Stock Fund, making it a revolving fund. The value of the fund is reviewed annually by Congress and adjusted to meet current requirements.

The Department of Defense has a similar fund to finance procurement of materials managed by the Defense Supply Agency (DSA).

The Appropriation Purchase Account is a stores account which reflects the value of materials purchased by a systems command, such as NavAir, and charged to an appropriation. When such material is issued from stock for use, the account is not reimbursed as it was with NSA material.

The cognizant symbol 2R depicted in table 3-1 designates the item of supply as being APA material and under the inventory control of the Aviation Supply Office (ASO). Although the cognizance symbol officially consists of two digits, it will be observed that some publications and requisitioning procedures frequently drop the first digit for APA material, thus 2R is referred to as R, etc.

Table 3-1 lists some of the more common cognizance symbols, with the type material controlled and inventory manager. The trend to single manager concept and the refinement of management techniques result in frequent change in these and other management codes. Such changes make it impractical to list all the cognizance symbols.

Material Control Codes

Material control codes divide inventories into segments reflecting similar demand, repairability, or other characteristics. For example, some material control codes reflect either fast or slow moving demand characteristics, while others denote whether the item is to be repaired at the Intermediate or Depot level of maintenance. Management techniques peculiar to vari-

Table 3-1.—Cognizance symbols

Cognizance symbol	Cognizant inventory manager	Stores account	Technical responsibility	Definition
0I	Naval Publications and Forms Center, Philadelphia	None	Navy Publications and Printing Service	Publications
1I	Naval Publications and Forms Center, Philadelphia	NSA	Navy Publications and Printing Service	Forms
1N	Navy Electronic Supply Office	NSA	Various systems commands	Electronic assemblies and repair parts
1R	Navy Aviation Supply Office	NSA	Naval Air Systems Command	Aeronautical, photographic, and meteorological material (consumable or expense type material)
1W	Navy Fuel Supply Office	NSA	Naval Supply Systems Command	Bulk and drummed liquid petroleum fuels, bulk lubricating oils, bulk drycleaning solvents, calibrating fluids and corrosion preventives, new and used drums, and miscellaneous petroleum items
2R	Navy Aviation Supply Office	APA	Naval Air Systems Command	Aeronautical, photographic, and meteorological material (repairable or investment type material)
2V	Naval Air Systems Command	APA	Naval Air Systems Command	Photographic, meteorological, and aeronautical support equipment
8R	Naval Air Systems Command	APA	Naval Air Systems Command	Major aeronautical systems and equipment
9Z	Navy Fleet Material Support Office	NSA	Various bureaus and commands	Navy owned stocks of defense industrial material

ous items of material can be easily recognized at all levels of responsibility by this code. In the preceding stock number example, material control code H designates the item as repairable, subject to scheduled overhaul at designated Navy rework facilities or commercial overhaul. All defective repairable material must be returned to supply for subsequent overhaul upon receipt of a replacement item. Some material control codes used with aeronautical material are listed in table 3-2.

Material Condition Codes

Material condition codes classify material in terms of readiness for issue and use, or identify action under way to change the status of material. For example, one material condition code is used to indicate that a particular item is serviceable and ready for issue. If, after issue from the supply system and through the use this item becomes unserviceable, its code would be changed to reflect the requirement for repair or overhaul. Naturally, upon completion of rework or repair, the material condition code would be changed to show that the item was once again serviceable and ready for issue. There are presently 13 different condition codes, letters A through N (less I), which may be assigned to Navy material. Since these codes apply to specific quantities of material, they do not appear in stock catalogs.

Federal Stock Number (FSN)

The federal stock number consists of the applicable four-digit classification code number from the federal supply classification plus a hyphen and the applicable seven-digit federal item identification number (FIIN).

FEDERAL SUPPLY CLASSIFICATION.–The federal supply classification (FSC) is a four-digit numerical code which comprises the first four digits of the FSN. It is used to identify stock items by commodity or descriptive category. The first two digits denote the group or major division of commodities. There are potentially 99 FSC groups. Many groups are unassigned. The second two digits denote the class or subdivision of commodities within a group. Table 3-3 lists some of FSC groups of concern to the AM. These groups will be encountered in requisitioning aviation materials, administrative supplies, and general shop maintenance materials. Knowing the FSC group will occasionally prove beneficial in locating information required to submit requests for material.

The cataloging Handbook H2-3 provides a complete alphabetical index for description to federal supply classification number. Figure 3-1 illustrates a page from this handbook.

The following are examples of FSC four-digit classes showing group and class breakdown:

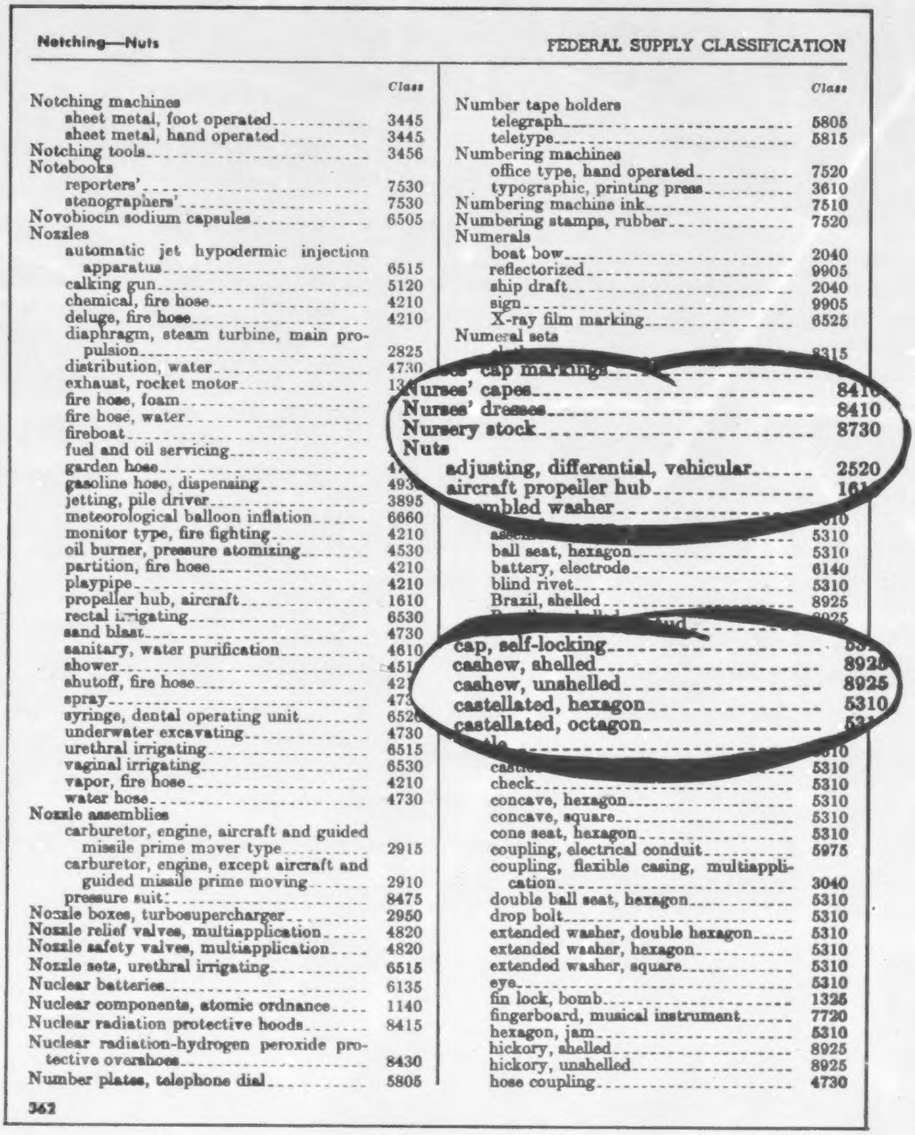
GROUP 16 Aircraft components and accessories	1610 - Aircraft propellers 1620 - Aircraft landings gear components 1630 - Aircraft wheels and brake systems
GROUP 53 Hardware and abrasives	5305 - Screws 5306 - Bolts 5307 - Studs 5310 - Nuts and washers 5320 - Rivets

The Defense Supply Agency Cataloging Handbooks, H2-1, H2-2, and H2-3 contain a complete listing of assigned federal supply classification classes.

FEDERAL ITEM IDENTIFICATION NUMBER.–The FIIN is a seven-digit number which identifies each item of supply used by the Department of Defense (DOD). The FIIN indexes or relates to identification data (information) which make an item of supply different from every other item of supply. The amount and type of identification data would depend on the item and its intended use. Although the FIIN is part of the federal stock number, it is used independently to identify an item. Most federal supply catalogs are arranged in FIIN order as will be illustrated in the section on material catalogs discussed later.

Special Material Identification Code (SMIC)

The special material identification code is a two-digit alphabetic or numeric code suffixing



Notching—Nuts

FEDERAL SUPPLY CLASSIFICATION

	Class
Notching machines	
sheet metal, foot operated	3445
sheet metal, hand operated	3445
Notching tools	3456
Notebooks	
reporters'	7530
stenographers'	7530
Novobiocin sodium capsules	6505
Nozzles	
automatic jet hypodermic injection apparatus	6515
calking gun	5120
chemical, fire hose	4210
deluge, fire hose	4210
diaphragm, steam turbine, main propulsion	2825
distribution, water	4730
exhaust, rocket motor	13
fire hose, foam	
fire hose, water	
fireboat	
fuel and oil servicing	
garden hose	47
gasoline hose, dispensing	493
jetting, pile driver	3895
meteorological balloon inflation	6660
monitor type, fire fighting	4210
oil burner, pressure atomizing	4530
partition, fire hose	4210
playpipe	4210
propeller hub, aircraft	1610
rectal irrigating	6530
sand blast	4730
sanitary, water purification	4610
shower	451
shutoff, fire hose	421
spray	473
syringe, dental operating unit	652
underwater excavating	4730
urethral irrigating	6515
vaginal irrigating	6530
vapor, fire hose	4210
water hose	4730
Nozzle assemblies	
carburetor, engine, aircraft and guided missile prime mover type	2915
carburetor, engine, except aircraft and guided missile prime moving	2910
pressure suit	8475
Nozzle boxes, turbosupercharger	2950
Nozzle relief valves, multiapplication	4820
Nozzle safety valves, multiapplication	4820
Nozzle sets, urethral irrigating	6515
Nuclear batteries	6135
Nuclear components, atomic ordnance	1140
Nuclear radiation protective hoods	8415
Nuclear radiation-hydrogen peroxide protective overshoes	8430
Number plates, telephone dial	5805

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	Class
Number tape holders	
telegraph	5805
teletype	5815
Numbering machines	
office type, hand operated	7520
typographic, printing press	3610
Numbering machine ink	7510
Numbering stamps, rubber	7520
Numerals	
boat bow	2040
reflectorized	9905
ship draft	2040
sign	9905
X-ray film marking	6525
Numeral sets	
[illegible]	8315
cap markings	
Nurses' capes	841
Nurses' dresses	8410
Nursery stock	8730
Nuts	
adjusting, differential, vehicular	2520
aircraft propeller hub	161
mbled washer	
[illegible]	310
asse	5310
ball seat, hexagon	5310
battery, electrode	6140
blind rivet	5310
Brazil, shelled	8925
[illegible]	925
[illegible]	
cap, self-locking	53
cashew, shelled	892
cashew, unshelled	8925
castellated, hexagon	5310
castellated, octagon	53
[illegible]	310
cast	5310
check	5310
concave, hexagon	5310
concave, square	5310
cone seat, hexagon	5310
coupling, electrical conduit	5975
coupling, flexible casing, multiapplication	3040
double ball seat, hexagon	5310
drop bolt	5310
extended washer, double hexagon	5310
extended washer, hexagon	5310
extended washer, square	5310
eye	5310
fin lock, bomb	1325
fingerboard, musical instrument	7720
hexagon, jam	5310
hickory, shelled	8925
hickory, unshelled	8925
hose coupling	4730

AK.78

Figure 3-1.—Cataloging Handbook H2-3—description to federal supply classification (FSC).

Table 3-2.–Material and control codes.

Code	Definition
A	Field activity control–Items on which continuous centralized item inventory is not exercised
D	Repairable locally– Capable of being repaired by using activities or their immediate supporting activity.
F	Fast–High system quantity demand.
G	HIVAC Repairables with unit price of $1,000 or more–Material subject to special transaction reporting from acquisition to final disposition.
H	Repairables other than G, X, or Q–Capable of being repaired by depot maintenance activities.
J	HIVAC Consumables with unit price of $1,000 or more–Material subject to special transaction reporting from acquisition to final disposition.
K	Military essential and critical high value asset control repairable item with a unit price of $1,000 or more.
L	Item of local stock or items pending FSN assignment.
M	Medium–Medium system quantity demand, mid dollar value.
N	Military essential and critical high value asset control consumable item with a unit price of $1,000 or more.
Q	Repairable high value items with unit price of less than $1,000.
R	Insurance–Essential item with unpredictable demand, long lead time, and difficult to procure.
S	Slow–Low system quantity demand, low dollar value.
V	High value consumable item other than those designated as HIVAC, with a unit price of less than $1,000.
X	Accountable aeronautical maintenance support equipment end item.
Z	Consumable items that are replaced during component rework operations at a rate of 100 percent.

Table 3-3.—FSC groups.

Group	Title
15	Aircraft and airframe structural components.
16	Aircraft components and accessories.
17	Aircraft launching, landing, and ground handling equipment.
26	Tires and tubes.
31	Bearings.
34	Metal working machinery.
40	Rope, cable, chain, and fittings.
42	Firefighting, rescue, and safety equipment.
43	Pumps and compressors.
47	Pipe, tubing, hose, and fittings.
48	Valves.
49	Maintenance and repair shop equipment.
51	Handtools.
52	Measuring tools.
53	Hardware and abrasives.
66	Instruments and laboratory equipment
68	Chemicals and chemical products.
69	Training aids and devices.
75	Office supplies and devices.
79	Cleaning equipment and supplies.
80	Brushes, paints, sealers, and adhesives.
84	Clothing and individual equipment.
91	Fuels, lubricants, oils, and waxes.
95	Metal bars, sheets, and shapes.

the federal stock number. It is used to identify items to aircraft models, engine models, certain commodities, and special projects or programs. The SMIC replaced the technical supply management code (TSMC) and the weapon supply management code (WSMC). Like many areas of supply where changes are made, a certain time element will be involved before all material catalogs are updated to reflect the SMIC.

The SMIC may be assigned by the inventory manager to an FSN when the FSN item requires source or quality control, design or figuration control, stocking issue and procurement control, and/or special testing, storage, handling, or inspection.

In the two-digit code the second digit has the greatest importance and gives the general usage of that particular item. The following is a listing of some of the more common second-position letters with their applications:

A – Attack aircraft
C – Cargo/transport aircraft
F – Fighter aircraft
H – Helicopters
P – Patrol aircraft
S – Antisubmarine aircraft
T – Trainer aircraft
U – Utility aircraft
X – Common/general items

The first-position letter has no meaning by itself. It merely subdivides the individual second-position letters. For example the second-position letter "A" signifies an attack aircraft. The first-position letter breaks down the general type of attack aircraft into specific models. Examples of this breakdown are DA for A-4 attack aircraft, FA for A-6 attack aircraft, and GA for the A-7 attack aircraft. The first-position letter does not mean the same thing when used with a different second letter. For example the letter "B" when used with the second letter "P" signifies a P-3 patrol aircraft. A cross reference listing of aircraft, engine, special systems, and general/common SMIC assignments is provided in the Aviation Supply Office publication, Foreward for List of Repairable Assemblies and List of Supporting Spare Parts of Navy Aviation Materials.

File Inventory Segment Code (FISC)

The FISC is a two-character code added to the SMIC. The first character is a number from 1 through 7 which identifies the ASO file or biweekly inventory segment; the second character is always a nonsignificant X. The FISC applies to R and V cognizant symbol material and is added to the FSN for the internal purpose of ASO.

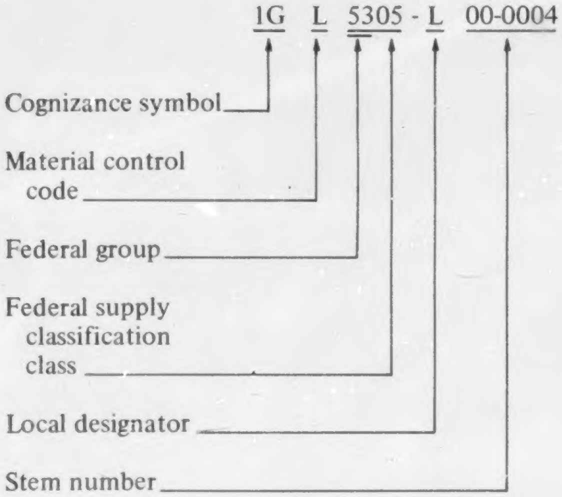
Local Stock Numbers

Certain material categories are exempted from the federal cataloging system. Those materials exempted include the following:

1. Items procured on a one-time basis for immediate use in research and development, experimentation, construction, or maintenance. These items are not subject to centralized item inventory management, reporting, or stock control.
2. Items procured locally and intended solely for local use or consumption, and not subject to centralized management, reporting, or stock control.
3. Items obtained through overseas procurement and intended solely for overseas use.
4. Items procured with nonappropriated funds.
5. Items source coded in a series other than the P series in applicable NavAir publications.

Local stock numbers may be assigned to items exempted from the federal cataloging system. A local stock number is constructed in the same format as a federal stock number with the material control code "L" signifying a local stock number.

The stem number is serially assigned starting with 00-0001. Each additional local stock number is assigned the next higher number as shown by the following example:



These local stock numbers have no supply system significance; they are used for local management purposes only. A listing of local stock numbers with applicable identification data is provided to applicable local commands. Stocks carried under these numbers are also reported to the cognizant inventory manager by supply to prevent duplication of manufacture or purchase of items and to give the manager an opportunity to identify the item to an existing FSN.

STANDARDIZATION OF ITEM NOMENCLATURE

As part of the federal cataloging system, each item of supply is assigned an official government name. Maintenance personnel frequently refer to material by trade name or terminology other than the official government name. Alphabetical indexes in the various stock catalogs and other publications are sequenced by official name. To effectively utilize these publications, it is necessary to become acquainted with the proper nomenclature.

The assignment of names to stock items is practically as important as the assignment of FSN's. When items are inducted into the supply system, official government nomenclature must be assigned. Often this item name plus additional descriptive data will differ from names of items previously used. If difficulty is experienced in locating a familiar item in the catalog, it is quite possible that the name has been changed to conform to a more general usage. A few examples will show the importance of correct item nomenclature. It will be found that a "swab" is a small stick with a tiny wad of cotton on one end, and is used by the Medical Department. In order to clean the decks it will be necessary to think of another name for "swab." "Mops" will be found listed in the catalog, together with the correct FSN. Other examples are as follows: "Ceilometer" becomes "Projector, Cloud Height"; "Zipper" has become "Fastener, Slide Interlocking," etc.

NAVAL MATERIAL CATALOGS

Federal and naval material catalogs provide the information necessary to identify and procure items of material for the operation and maintenance of activities ashore and afloat. How and which catalogs to use will become apparent in this section and the following section on identification source data.

Illustrated Parts Breakdown (IPB)

The IPB and allowance lists continue to be the most important source for obtaining information necessary to order specific aircraft parts at the Organizational level of maintenance. Property used, they will provide reference information necessary to identify a part number to the specific model aircraft and in some cases provide interchangeability data that can be utilized when the prime item requested is not in stock. Parts interchangeability will be discussed in greater detail later in this chapter.

An Illustrated Parts Breakdown, also known as Illustrated Maintenance Parts List or Illustrated Parts Catalog, is prepared by the manufacturer for each model aircraft, engine, accessory, electronic equipment, or other aeronautical equipment considered advisable by NavAirSysCom and is printed and issued by the authority of NavAirSysCom. The IPB is designed to enable supply and maintenance personnel to identify and order replacement parts for the aircraft or equipment. All procurable assemblies and detail parts are illustrated and listed in such a manner as to make possible quick identification of assemblies and their component parts. The items are arranged continuously in assembly breakdown order with the illustrations placed as near as possible to their appropriate listing.

Although slight variations in format exist among the various IPB's, each usually includes the following major sections.

The TABLE OF CONTENTS shows the breakdown of the publication into sections. It also furnishes an alphabetical listing of the various assemblies and lists the page or figures where they are illustrated.

The INTRODUCTION includes general information and instructions for using the publication. It should be referred to prior to using an unfamiliar IPB.

The GROUP ASSEMBLY PARTS LIST is the main text of the publication. It consists of a series of illustrations and parts lists in which parts of the aircraft or equipment are shown in assembly-breakdown order. The illustrations and parts lists are keyed to each other by means of figure and index numbers.

Each assembly included in the parts list is followed immediately by its component parts properly indented to show their relationship to the assembly.

The group assembly parts list is subdivided into groups such as wing group, tail group, and fuselage. Some IPB's are multiple volume, and each group makes up a separate volume.

The NUMERICAL INDEX lists all parts numerically in part number order, and each part number is cross-referenced to the figure and index number where it is illustrated. This section also shows the total quantity of each part used in the aircraft or equipment, material source code, and federal stock number when applicable.

The MASTER LOCATOR INDEX replaces the numerical index for some aircraft IPB volumes. The master locator index is used to locate the manual in which a part number will appear when only the part number is known. The part numbers are listed in alphanumerical order. The manual number appearing in the manual No. column refers to the last dash number of the NavAir manual number. For example: If the number shown in the manual No. column of the A-6 master locator index is 8, complete information on the part will be found in IBP volume, NavAir 01-85-ADA-4-8. The master locator index, unlike the numerical indexes, does not always provide source, maintenance, and recoverability information.

When using the IPB, consider if a failed part is one that was installed as a result of a technical directive, the part number may not appear in the IPB. The index manual for the IPB volumes will include a list of directives which have been incorporated into the IPB's. For information on parts where the directive has not been incorporated, the directive may provide the necessary information for ordering a replacement item.

Navy Management Data List

The Navy Management Data List (NMDL) consists of two separate sections. One section, the Fleet Ballistics Missile Weapons System Supplement, has application only to submarine forces and therefore is of little or no use to aviation maintenance personnel.

The other section, titled the Management Data List, includes basic management data necessary for preparing material requisitions. Also, it is the instrument for publishing data relative to stock number changes, unit of issue, unit price, shelf life of material, number of items contained in a package, and associated information.

The NMDL is designed to disseminate management type information as it relates to the FSN. It is not designed to be a comprehensive catalog of material in the supply system or to identify an item to an FSN; therefore, it cannot be used as a shopping guide. It is printed in federal item identification number sequence. In order to get the necessary FSN or other information needed to make effective use of the NMDL, additional publications must be used in conjunction with the NMDL. Some of these are discussed in the following section.

Descriptive/Identification Lists and Illustrated Shipboard Shopping Guides

Descriptive type catalogs or Identification Lists (IL's) are available on all FSC group materials. These lists catalog material by what it is rather than by what it is used on. These catalogs are similar to the Sears-Roebuck/Montgomery-Ward type catalogs, which have a comprehensive alphabetical index, group like items together, and thoroughly describe the items (size, weight, composition, etc.).

The Illustrated Shipboard Shopping Guides (ISSG) are similar in many ways to the IL's. They are designed to assist fleet personnel in identifying those items of supply not normally related to a part number or reference number to an FSN. They also provide assistance in determining substitute items by virtue of illustrations, specifications, and narrative descriptions from which data can be compared.

The ISSG is a multivolume publication consisting of an introduction and master index plus a number of individual sections applicable to material in the specific federal supply classes or groups.

The master index provides an alphabetical sequence listing of all item names included in the ISSG, with reference to the individual sections (FSC group or class) wherein they appear. The index is similar to that shown in figure 3-1.

Figure 3-2 illustrates a page from the illustrated shipboard shopping guide, section 5310.

Equipment Lists

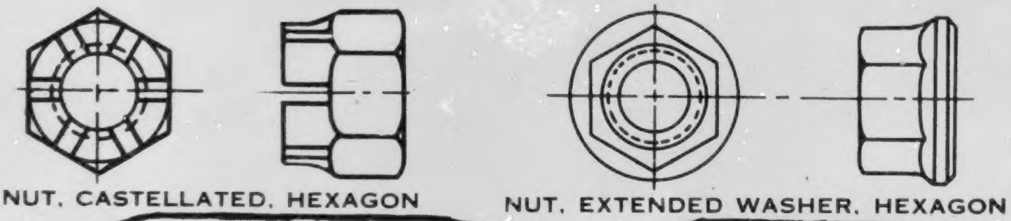
Equipment lists catalog material according to the type of equipment or aircraft it is designed for rather than what it is. Currently there are three types of equipment lists. The Weapons Equipment Lists (WEL) are lists of repairable assemblies, supporting repair parts, attaching parts, loose equipment, and accessories used on various aircraft. For example, the WEL 0076 is applicable to the A-7A aircraft and the WEL 0080 is applicable to the F-4 series aircraft. ASO is in the process of developing a Weapon Equipment List for each type of aircraft; however, not all aircraft used within the Navy have WEL's as of this writing.

Figure 3-3 illustrates the repairable assemblies and supporting repair parts section, the attaching parts, loose equipment and accessories section, the part (reference) number to federal item identification number (FIIN) index, and the FIIN to part number index of a typical WEL. The WEL is a comprehensive multivolume publication containing the four sections illustrated in figure 3-3 and all the management data necessary for identification and procurement of items for the aircraft type covered. Introductory pages of the WEL contain an explanation of various codes, information on how to use the WEL as well as a listing of allowance and initial outfitting lists, a listing of technical manuals, and a listing of major avionics equipment applicable to the specific weapon system.

Maintenance personnel will find that the WEL can be a convenient source of data required when requesting aircraft parts and equipment. The WEL, when applicable, would normally be located in the material control work center.

"Equipment Lists" containing information on specific types of equipment such as survival equipment, aircraft tires and tubes, and specialized shipping containers and Support Equipment

REPRESENTATIVE NUT STYLES



NUT, CASTELLATED, HEXAGON

LLUSTRATION SECTION

CHAMFERED OR WASHER FACED

ALUMINUM ALLOY, ANODIZED

UNF OR NF CLASS 3B THD OR 3 FIT

FIIN	THREAD DATA	W ACROSS FLATS	O/A HEIGHT
		IN.	IN.
167-1271	#10-32	0.375	0.250
167-1272	1/4-28	0.437	0.281
167-1273	5/16-24	0.500	0.328
167-1274	3/8-24	0.562	0.406
167-1275	7/16-20	0.625	0.453
167-1276	1/2-20	0.750	0.562
167-1277	9/16-18	0.875	0.609
167-1278	5/8-18	1.000	0.719

BRASS, UNCOATED

UNC CLASS 2B THD OR 2 FIT

FIIN	THREAD DATA	W ACROSS FLATS	O/A HEIGHT
		IN.	IN.
189-2796	1/4-20	0.437	0.281
189-2797	5/16-18	0.500	0.328
189-2798	3/8-16	0.562	0.406
189-2800	1/2-13	0.750	0.562
189-2802	5/8-11	0.937	0.719

UNF CLASS 2B THD OR 2 FIT

FIIN	THREAD DATA	W ACROSS FLATS	O/A HEIGHT
		IN.	IN.
189-2835	1/4-28	0.437	0.281
189-2811	3/8-24	0.562	0.406
579-3189	1/2-20	0.750	0.562
189-2841	5/8-18	0.937	0.719
189-2842	3/4-16	1.125	0.812

STEEL, UNCOATED

UNC CLASS 2B THD OR 2 FIT

FIIN	THREAD DATA	W ACROSS FLATS	O/A HEIGHT
		IN.	
	5/16-18	0.500	

STEEL,CORROSION RESISTING, PASSIVATED

UNF CLASS 2B THD OR 2 FIT

FIIN	THREAD DATA	W ACROSS FLATS	O/A HEIGHT
		IN.	IN.
188-8955	1/4-28	0.437	0.281
188-8956	5/16-24	0.500	0.328
188-8957	3/8-24	0.562	0.406
188-8958	7/16-20	0.625	0.453
188-8959	1/2-20	0.750	0.562
265-6753	9/16-18	0.875	0.609
265-6754	5/8-18	0.937	0.718
188-8962	3/4-16	1.062	0.812
188-8964	1-14	1.437	1.000

NUT, EXTENDED WASHER, HEXAGON

SEE ILLUSTRATION SECTION

PREVAILING TORQUE ALL METAL DESIGN

STEEL, CADMIUM PLATED

NC CLASS 3B THD OR 3 FIT

FIIN	THREAD DATA	W ACROSS FLATS	OD WSHR	O/A HEIGHT
		IN.	IN.	IN.
807-1471	#4-40	0.158	0.206	0.125
807-1472	#6-32	0.190	0.244	0.141
807-1473	#8-32	0.221	0.290	0.188

NF CLASS 3B THD OR 3 FIT

FIIN	THREAD DATA	W ACROSS FLATS	OD WSHR	O/A HEIGHT
		IN.	IN.	IN.
	#10-32	0.252	0.330	0.188
	-28	0.316	0.420	0.219
			0.520	0.266
			20	0.282

NUT, PLAIN, CAP

SEE ILLUSTRATION SECTION

CHAMFERED OR WASHER FACED

STEEL, ZINC COATED

UNF CLASS 2B THD OR 2 FIT

FIIN	THREAD DATA	W ACROSS FLATS	O/A HEIGHT
		IN.	IN.
199-7601	1/4-28	0.437	0.470
199-7602	5/16-24	0.500	0.530
199-7603	3/8-24	0.562	0.620
199-7605	1/2-20	0.750	0.810
199-7607	5/8-18	0.937	1.000

STEEL,CORROSION RESISTING, PASSIVATED

UNC OR NC CLASS 2B THD OR 2 FIT

FIIN	THREAD DATA	W ACROSS FLATS	O/A HEIGHT
		IN.	IN.
199-7635	#6-32	0.312	0.340
199-7636	#8-32	0.312	0.340
199-7637	#10-24	0.375	0.410
199-7639	1/4-20	0.437	0.470
199-7640	5/16-18	0.500	0.530
199-7641	3/8-16	0.562	0.620
199-7642	7/16-14	0.625	0.690
199-7643	1/2-13	0.750	0.810
199-7645	5/8-11	0.937	1.000
199-7646	3/4-10	1.062	1.160

UNF OR NF CLASS 2B THD OR 2 FIT

FIIN	THREAD DATA	W ACROSS FLATS	O/A HEIGHT
		IN.	IN.
199-7653	#10-32	0.375	0.410
199-7655	1/4-28	0.437	0.470
199-7656	5/16-24	0.500	0.530
199-7657	3/8-24	0.562	0.620
199-7659	1/2-20	0.750	0.810

NUT, PLAIN, HEXAGON

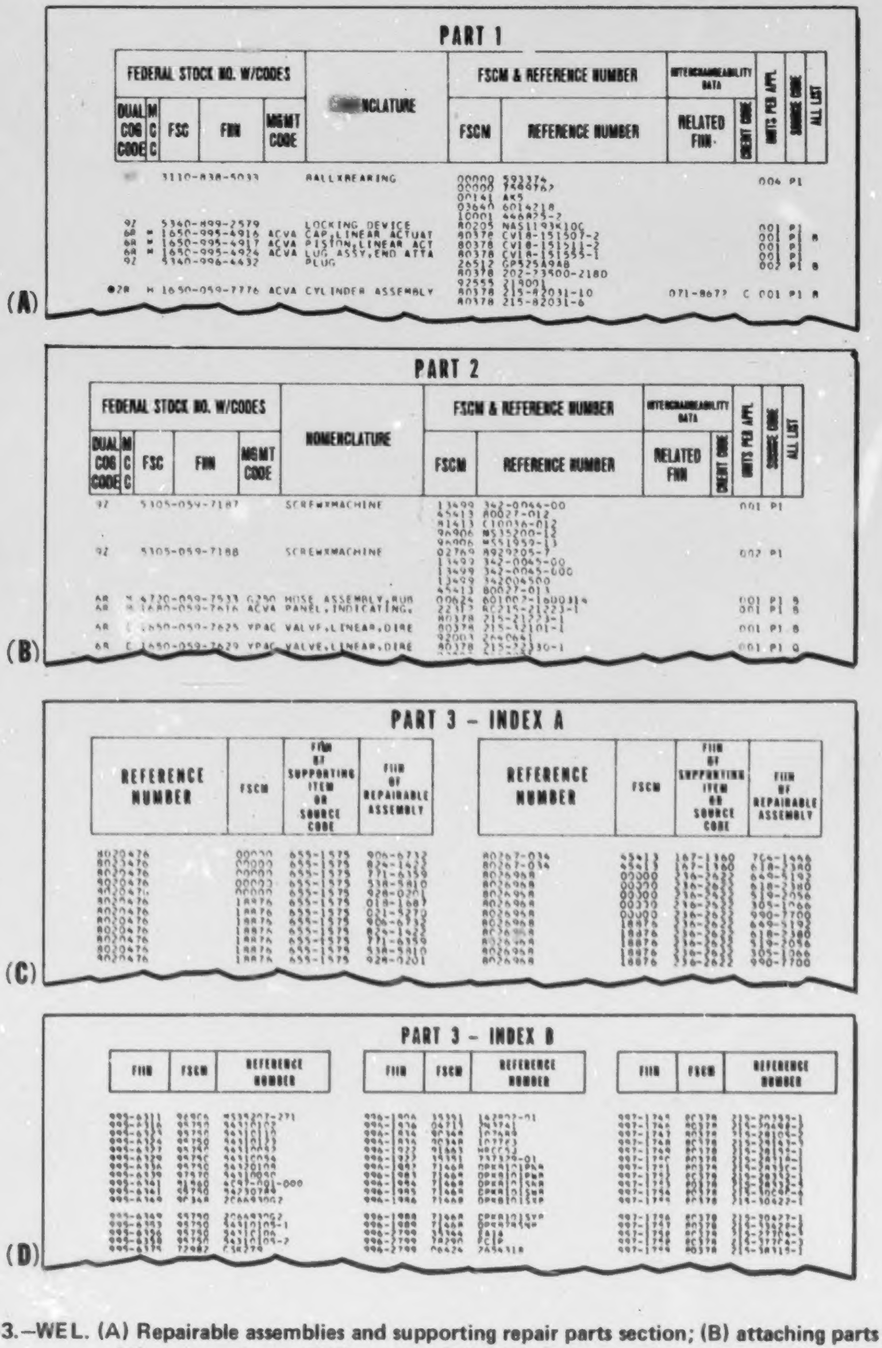
SEE ILLUSTRATION SECTION

CHAMFERED OR WASHER FACED

	THREAD

AK.79

Figure 3-2.—ISSG, section 5310.



PART 1

FEDERAL STOCK NO. W/CODES					[illegible]NCLATURE	FSCM & REFERENCE NUMBER		INTERCHANGEABILITY DATA		UNITS PER APPL	SOURCE CODE	ALL LIST
DUAL COG CODE	M C C	FSC	FIIN	MGMT CODE		FSCM	REFERENCE NUMBER	RELATED FIIN	CREDIT CODE			

```
        3110-838-5033        BALLXBEARING          00000 593374               006 P1
                                                   00000 7580767
                                                   00141 AK5
                                                   03640 6014218
                                                   10001 446A25-2
9Z      5340-899-2579        LOCKING DEVICE        80205 NAS1193K10C          001 P1
6R  M   1650-995-4916 ACVA   CAP,LINEAR ACTUAT     80378 CV18-151507-2        001 P1 R
6R  M   1650-995-4917 ACVA   PISTON,LINEAR ACT     80378 CV18-151511-2        001 P1
6R  M   1650-995-4924 ACVA   LUG ASSY,END ATTA     80378 CV18-151555-1        001 P1
9Z      5340-996-4432        PLUG                  26512 GP525A9AB            002 P1 R
                                                   80378 202-23500-2180
                                                   92555 219001
●2R  H  1650-059-7776 ACVA   CYLINDER ASSEMBLY     80378 215-82031-10    071-8672 C 001 P1 R
                                                   80378 215-82031-6
```

PART 2

FEDERAL STOCK NO. W/CODES					NOMENCLATURE	FSCM & REFERENCE NUMBER		INTERCHANGEABILITY DATA		UNITS PER APPL	SOURCE CODE	ALL LIST
DUAL COG CODE	M C C	FSC	FIIN	MGMT CODE		FSCM	REFERENCE NUMBER	RELATED FIIN	CREDIT CODE			

```
9Z      5305-059-7187        SCREWXMACHINE         13499 342-0044-00          001 P1
                                                   45413 80027-012
                                                   81413 C10036-012
                                                   96906 MS35200-12
                                                   96906 MS51959-13
9Z      5305-059-7188        SCREWXMACHINE         02769 A929205-7            002 P1
                                                   13499 342-0045-00
                                                   13499 342-0045-000
                                                   13499 342004500
                                                   45413 80027-013
6R  M   4720-059-7533 G250   HOSE ASSEMBLY,RUB     00624 601002-1600314       001 P1 R
6R  M   1680-059-7616 ACVA   PANEL,INDICATING,     22312 RC215-21223-1        001 P1 R
                                                   80378 215-21223-1
6R  C   1650-059-7625 YPAC   VALVE,LINEAR,DIRE     80378 215-32101-1          001 P1 R
                                                   92003 2640641
6R  C   1650-059-7629 YPAC   VALVE,LINEAR,DIRE     80378 215-22330-1          001 P1 R
```

PART 3 – INDEX A

REFERENCE NUMBER	FSCM	FIIN OF SUPPORTING ITEM OR SOURCE CODE	FIIN OF REPAIRABLE ASSEMBLY	REFERENCE NUMBER	FSCM	FIIN OF SUPPORTING ITEM OR SOURCE CODE	FIIN OF REPAIRABLE ASSEMBLY
8020476	00000	655-1575	906-6732	80267-034	45413	167-1360	706-1466
8020476	00000	655-1575	824-1422	80267-034	45413	167-1360	618-2380
8020476	00000	655-1575	771-6359	8026968	00000	336-2622	649-5192
8020476	00000	655-1575	538-5810	8026968	00000	336-2622	618-2380
8020476	00000	655-1575	928-0201	8026968	00000	336-2622	519-2056
8020476	18876	655-1575	018-1687	8026968	00000	336-2622	305-1066
8020476	18876	655-1575	021-5270	8026968	00000	336-2622	990-7700
8020476	18876	655-1575	906-6732	8026968	18876	336-2622	649-5192
8020476	18876	655-1575	824-1422	8026968	18876	336-2622	618-2380
8020476	18876	655-1575	771-6359	8026968	18876	336-2622	519-2056
8020476	18876	655-1575	538-5810	8026968	18876	336-2622	305-1066
8020476	18876	655-1575	928-0201	8026968	18876	336-2622	990-7700

PART 3 – INDEX B

FIIN	FSCM	REFERENCE NUMBER	FIIN	FSCM	REFERENCE NUMBER	FIIN	FSCM	REFERENCE NUMBER

AM.440

Figure 3-3.—WEL. (A) Repairable assemblies and supporting repair parts section; (B) attaching parts section; (C) part number to FIIN section; (D) FIIN to part number section.

Lists (SEL's) that provide a listing of part numbers and FSN's that are applicable to selected types of ground support equipment are also being developed.

Navy Deleted and Superseded FIIN List (DSFL)

The Navy Deleted and Superseded FIIN List is the historical record of stock number deletions and supersessions. The DSFL is printed in old FIIN sequence and lists old FIIN's which have been canceled and cross references old FIIN's to superseding FIIN's. In the event that an old FIIN was superseded more than once, it will cross reference to the latest FIIN. The change notice code indicates the reason for cancellation or supersession of the old FIIN.

NOTE: The DSFL does not constitute automatic authority to substitute or effect interchangeability. The change notice code should be considered and the items end use application must be known to determine if the superseding FIIN is a valid replacement item.

Consolidated Reparable Item List (CRIL)

The Consolidated Reparable Item List contains a listing of Navy managed mandatory turn-in reparable items. It is prepared to assist in identifying Navy managed mandatory turn-in reparable items and pertinent movement priority designators. Some reparable items under the cognizance of ASO and the NavAirSysCom are not included in this publication. These are listed in the ASO Master Repair List.

Cross Reference Lists

The term "cross reference list" is a general term normally relating to cross referencing between reference numbers/manufacturer's part numbers, and federal stock numbers. Most catalogs published by the Navy or the Defense Supply Agency have a cross reference section listing part numbers and stock numbers of items contained herein.

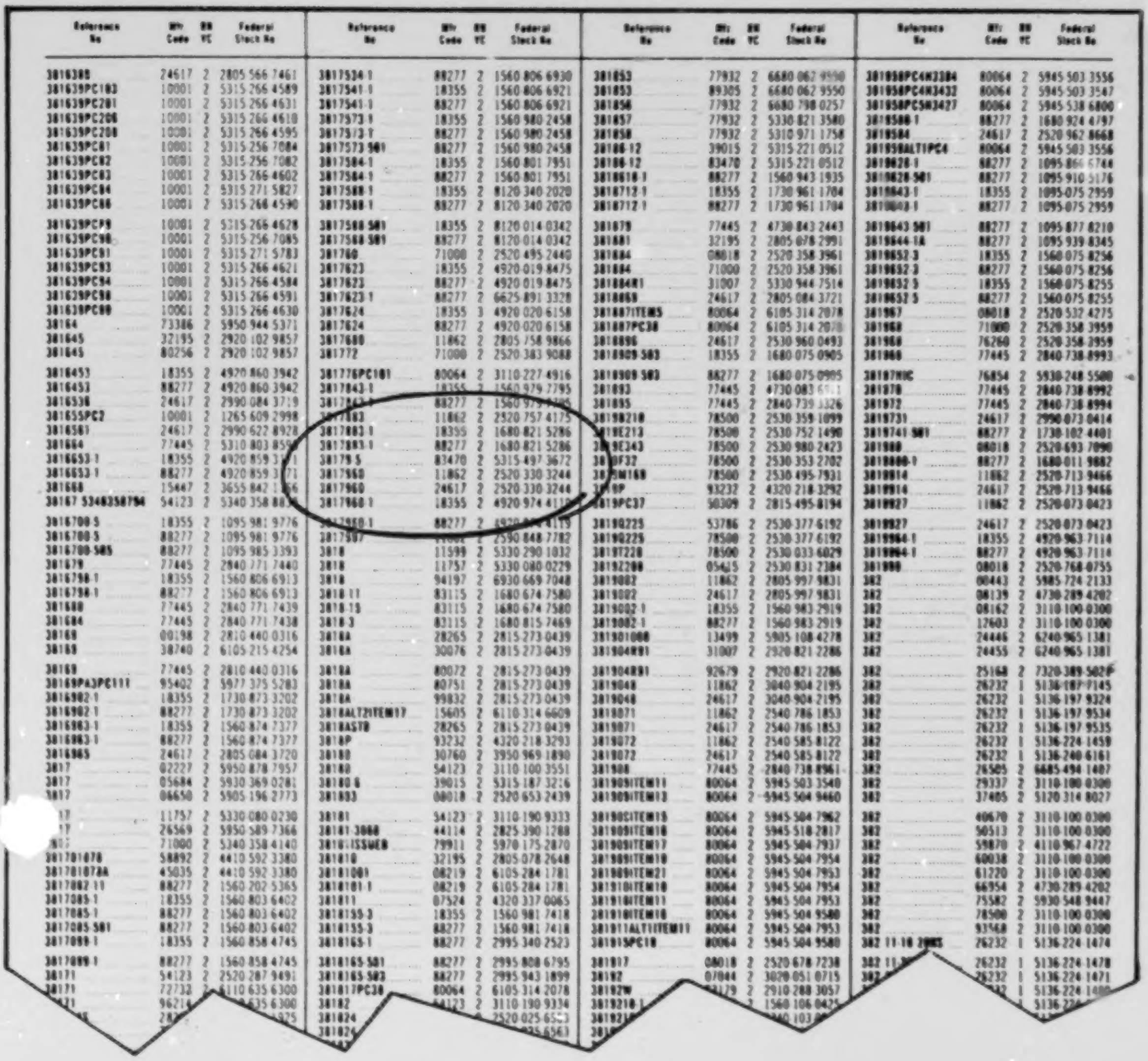
A master cross reference list (MCRL) is the term applied to a publication which accumulates and consolidates the information from all the separate cross reference lists. The Defense Logistics Services Center (Defense Supply Agency) publishes an MCRL for the Navy which is distributed by the Fleet Material Support Office (FMSO). Also, ASO publishes an MCRL entitled "ASO Cross Reference for Naval Aviation Interest Items—Part Number to Federal Stock Number." (ASO section C0006). The FMSO MCRL is a more comprehensive publication (approximately 24 volumes plus a multi-volume supplement) and contains information of interest to all elements of the Navy. ASO's MCRL, along with C0006A (variation code supplement), is tailored to aviation requirements. It would be the preferred MCRL for aviation supply support activities.

Figure 3-4 illustrates a page from the MCRL published by the Defense Logistics Services Center. The data is arranged in reference number sequence, with its applicable Manufacturer's Code (FSCM), Reference Number Variation Code, and FSN shown in adjacent columns. Like many other supply publications, the MCRL is being converted to microfilm (microfiche) to reduce space requirements for storage and use. For example, a typical microfiche, which is a 4" by 6" piece of negative film, can contain over 300 pages of data.

It is recommended in looking up a reference number that the various methods of representing the number be recognized. If the number cannot be found in the form represented in the IPB or found on the part itself, try various arrangements of the part number before assuming its exclusion. For example:

13 7BCAL 23B
13-7BCAL-23B
13-7BCAL23B
137BCAL-23B
137BCAL-23B
137BCAL23B

Once the FSN is located, it will be necessary to cross reference the FSN in the management data list, the list of reparable assemblies, or one of the other previously mentioned catalogs to verify that the part number has been cross referenced to the correct part by checking the nomenclature in addition to the manufacturer's code provided by the MCRL.



AK.71

Figure 3-4.—Federal Supply Catalog MCRL.

The federal supply code for the manufacturer can be crossed to the manufacturer's name by using the Federal Supply Code for Manufacturers (Code to Name) Cataloging Handbook H4-2.

When identical reference numbers are identified to the same FSCM but to two or more different stock numbers, the reference number variation code 2 will indicate that additional data is required to correctly identify the item of supply. In cases of this sort, the Variation Data Supplement List for the MCRL should be checked to aid in correct identification. Figure 3-5 is a portion of the page from a supplement showing amplifying information necessary to identify items with the same reference number and FSCM but several FSN's.

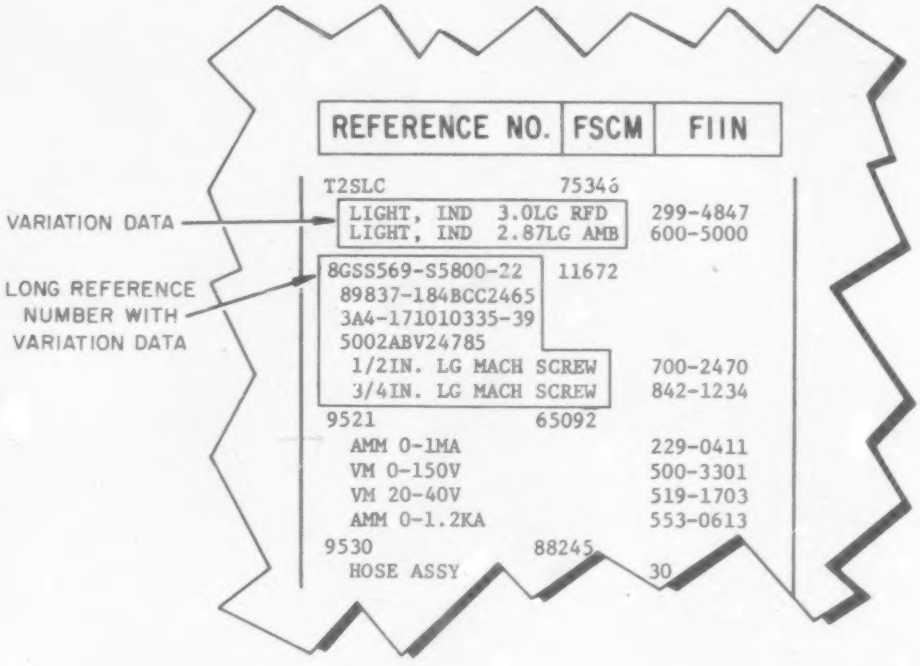
Other specialized MCRL's published by ASO include:

1. Section C0017, Master Cross Reference of Parts Kits–identifies repairable assemblies to their repair parts kits.
2. Section C0018, Model Code Cross Reference List–identifies ASO's model codes, which appear in various ASO catalogs, to the FSN's of the repairable assemblies to which they apply.

The C0017 is an essential element in component repair by AIMD. It lists the components that are supported by repair parts kits and lists the respective kits. It is published in two parts. Part 1 lists the component to be repaired by part number in alphanumeric sequence, the federal supply code for manufacturer (FSCM), and the FSN. In addition, on the same line are listed the part number, FSCM, FSN, and source code for the applicable repair parts kit. Part 2 lists the components to be repaired by FSN, in FIIN sequence, and beside it on the same line is the FSN of that component's repair parts kit.

Listing of Repairable Assemblies and Supporting Repair Parts, ASO Sections P2300 and P2310

ASO P2300, List of Repairable Assemblies of Navy Aviation Materials, lists all repairable assemblies under the cognizance of ASO or NavAir. It is published in two parts. Part one is listed in FIIN sequence and designed to serve as a master reference list for identifying and



REFERENCE NO.	FSCM	FIIN
T2SLC	75346	
LIGHT, IND 3.0LG RFD		299-4847
LIGHT, IND 2.87LG AMB		600-5000
8GSS569-S5800-22	11672	
89837-184BCC2465		
3A4-171010335-39		
5002ABV24785		
1/2IN. LG MACH SCREW		700-2470
3/4IN. LG MACH SCREW		842-1234
9521	65092	
AMM 0-1MA		229-0411
VM 0-150V		500-3301
VM 20-40V		519-1703
AMM 0-1.2KA		553-0613
9530	88245	
HOSE ASSY		30

VARIATION DATA
LONG REFERENCE NUMBER WITH VARIATION DATA

AM.903

Figure 3-5.–Navy Cross Reference List–Supplementary Data.

requisitioning repairable assemblies. Part two lists aircraft engines. Figure 3-6 illustrates a portion of a typical page from P2300 Part 1.

ASO P2310, List of Supporting Repair Parts of Navy Aviation Materials, is also listed in FIIN sequence and the same format as P2300 and is designed to serve as a master reference list for identifying and requisitioning all significant replacement parts required to support the repairable assemblies listed in P2300.

The content and arrangement of P2300 and P2310 are explained in the "Foreword for List of Repairable Assemblies and List of Supporting Repair Parts of Navy Aviation Materials" P2999. Awareness and use of these publications can enhance the expeditions repair efforts of supply and maintenance personnel.

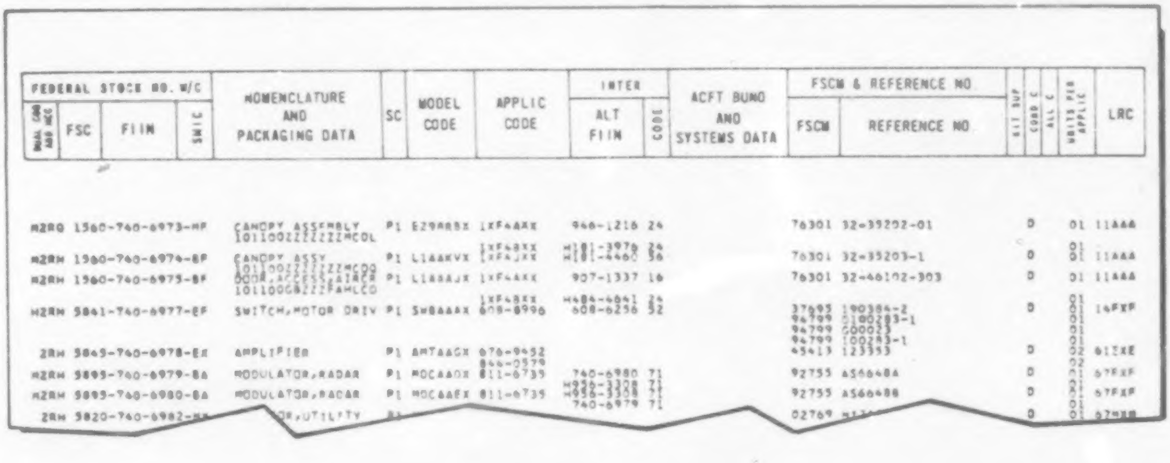
Interchangeability

Occasionally, repairable aircraft components ordered are not in stock and substitute parts are issued by supply to fill the requisition. While it is generally supply's responsibility to insure that these parts are in fact acceptable for substitution, the mechanic also bears a portion of this responsibility.

The illustrated parts breakdown provides interchangeability information through the use of usable-on-codes. Section B allowance lists, explained later in this chapter, also lists a prime FSN and provide information in the nomenclature column on alternate and interchangeable items.

The official definition of an interchangeable item is one which possesses such functional and physical characteristics as to be equivalent in performance, reliability, and maintainability to another item of similar or identical purpose; and is capable of being exchanged for the other item without selection for fit or performance and without alteration of the items themselves or of adjoining items, except for adjustment. Such parts could and frequently do have different internal parts.

ASO publications such as P2300 and P2310 (covered earlier) also provide interchangeability data. In these publications the preferred items and interchangeable items are designated by the letter H (preferred item) or the letter M (interchangeable item). These letters will appear to the left of the applicable FSN. Supply publications and personnel will refer to like items as members of the family. The preferred item is



FEDERAL STOCK NO. W/C				NOMENCLATURE AND PACKAGING DATA	SC	MODEL CODE	APPLIC CODE	INTER		ACFT BUNO AND SYSTEMS DATA	FSCM & REFERENCE NO		ALT SUP	COND C	ALL C	UNITS PER APPLIC	LRC
[illegible]	FSC	FIIN	SMIC					ALT FIIN	CODE		FSCM	REFERENCE NO					
H2RQ	1560	740-6973	HP	CANOPY ASSEMBLY 1011002ZZZZZZHCOL	P1	EZ9ARBX	1XF4AXX	946-1216	24		76301	32-35292-01		D		01	11AAA
H2RH	1560	740-6974	BP	CANOPY ASSY 1011002ZZZZZZHCOQ	P1	L1AAKVX	1XF4BXX 1XF4JXX	H181-3976 H181-4460	24 36		76301	32-35203-1		D		01 01	11AAA
H2RH	1560	740-6975	BF	DOOR,ACCESS,AIRCR 1011006BZZZFAHLCO	P1	L1AAAJX	1XF4AXX	907-1337	16		76301	32-46102-303		D		01	11AAA
H2RH	5841	740-6977	EF	SWITCH,MOTOR DRIV	P1	SWBAAAX	1XF4BXX 608-8996	H484-4841 608-6256	24 52		37695 94799 94799 94799	190384-2 D100283-1 G00023 100283-1		D		01 01 01 01 01	14FXF
2RH	5845	740-6978	EX	AMPLIFIER	P1	AMTAAGX	676-9452 844-0579				45413	123353		D		02 02	61ZXE
H2RH	5895	740-6979	BA	MODULATOR,RADAR	P1	MOCAAOX	811-6735	740-6980 H956-3308	71 71		92755	AS66484		D		01 01	67FXF
H2RH	5895	740-6980	BA	MODULATOR,RADAR	P1	MOCAAEX	811-6735	H956-3308 740-6979	71 71		92755	AS66488		D		01 01	67FXF
2RH	5820	740-6982		OR,UTILITY							02769			D		01	

AM.441

Figure 3-6.—List of repairable assemblies, typical page (P2300).

called the head (thus the H designation) and the interchangeable item is called a member of the family (thus the M designation). A two digit alternate FIIN relationship code located in the interchangeability column further denotes parts consideration, and item ,preference and the usability classification. Interchangeability data for ASO P2300 and P2310 is defined in detail in P2999, the foreword for use of these two publications. Maintenance personnel need only be aware that these codes exist in the event the degree of suitability or interchangeability is questionable on receiving a substitute part from supply.

Parts that are not known to be interchangeable should not be installed as substitute items without being subjected to careful comparison utilizing the variety of interchangeability data available.

IDENTIFICATION SOURCE DATA

Positive identification of an item of supply has been accomplished when it is identified to its applicable federal stock number. When the FSN is available, other required information, such as application, physical characteristics, etc., is easily obtained by referring to the appropriate supply catalog. The FSN is not normally marked on aircraft parts; however, most material has some type of data affixed to it that can be used for identification purposes. Certain data which does not identify an item but which aids in obtaining positive identification is discussed in the following paragraphs.

Manufacturer's Part Number

Normally, the manufacturers or parts stamp, etch, paint, or otherwise affix a part number on each item manufactured. The use of this manufacturer's part number and the knowledge of the part's application (that is, aircraft or equipment on which used) normally lead to the positive identification of the part's nomenclature and federal stock number. The part number can be ascertained to be correct by reference to the appropriate Illustrated Parts Breakdown (IPB), and the federal stock number may be obtained by reference to the appropriate Master Cross Reference Listing (MCRL).

Reference Number

The term reference number refers to a number assigned by the manufacturer or contractor. Part, serial, drawing, catalog, and specification numbers are all types of reference numbers. However, for the purpose of this training manual, reference numbers relative to the identification of material are considered synonymous to parts numbers.

Drawing Number

A drawing number consists of letters, numbers, or a combination of both which are assigned to a particular drawing for identification purposes. The activity controlling the drawing (normally the manufacturer) assigns the number in conformance with their drawing number system. One drawing may apply to several items; thus, other distinguishing data may be necessary to identify the item on the drawing.

Drawing numbers may be used to identify the microfilm available in some technical libraries. Some large assemblies are illustrated in the appropriate Illustrated Parts Breakdown but are not broken down sufficiently to show identifying data for their component parts. By obtaining the drawing number of the larger item and cross-referencing it to the applicable microfilm, sufficient identifying information for the component part may be obtained.

Nameplates

Some aeronautical materials have nameplates attached which provide such information as the manufacturer's name or code, make or model number, serial number, size, voltage, phase, etc. Identification data taken from the nameplate of the old part can be very helpful in identifying and procuring a replacement. Nameplate data is particularly useful when requesting nonstandard material which is not subject to the federal cataloging system.

Markings and Measurements

Special coded markings, other than part numbers, and measurements often aid in the identification of some materials. For instance, compressed gas cylinders are color coded to identify the contents of the cylinders. Sheet metal is stamped with a significant identifying symbol which is repeated at intervals throughout the length of the sheet. This symbol includes the composition, temper, thickness, etc.

Flexible rubber hose is marked with a symbol which is repeated at intervals throughout the length of the hose. Bare wire is separated according to diameter. Tubing has two types of measurements–outside diameters, given in inches; and thickness of the wall, given in thousandths of an inch. Female fittings such as crosses, tees, and couplings are measured across the inside diameter of the threaded opening. The male fittings are measured across the outside diameter of the male threads.

Source, Maintenance, and Recoverability Codes (SM & R)

Source, maintenance, and recoverability codes are used in the various IPBs and allowance lists to identify the source of spares, repair parts, and items of support equipment and the levels of maintenance authorized to maintain, repair, overhaul, or condemn them.

The coding will control the range of parts procured to support new equipments and expedite the maintenance, repair, and overhaul of aeronautical equipments by providing maintenance and supply personnel with the necessary information relative to the source of supply and, where applicable, the maintenance implications and recoverability status of items.

The SM & R code format consists of a 6-digit number comprised of three parts–a two-position source code, a three-position maintenance code, and a one-position recoverability code. The source code indicates the means of acquiring the item.

The third-position maintenance code indicates to maintenance and supply personnel the lowest level of maintenance authorized to remove and replace the item.

The fourth-position maintenance code indicates the lowest maintenance level authorized to accomplish repair, overhaul, or assembly of the item. Code Z in this position indicates that no repair is expected to be made at any level.

The fifth-position maintenance code indicates the lowest maintenance level authorized to condemn the items when repair or overhaul at this level or higher level is not economically or militarily justified.

The recoverability code indicated in the sixth position indicates special instructions on reclamation or disposition actions required on the item. Use of this position is temporarily being held in abeyance pending greater Department of Defense standardization of the codes. Material accountability/recoverability codes (MARC) are to be used separately pending approval of these codes for inclusion in the SM & R code format. An example of an SM & R code is PIHZH. Complete information on SM & R codes is provided in the latest issuance of NAVAIR INST. 4423.3.

SOURCE CODES.–Item source codes are symbols which indicate the source of supply for an item required to maintain or repair a component part of an aircraft. Specifically, these codes indicate whether the item is to be requisitioned from the supply system; to be manufactured; to be obtained from salvage; not to be replaced since the next higher assembly is to be installed; or, due to failure, is in need of complete overhaul or retirement of the assembly or equipment from service.

NavAirSysComRep's are responsible for the initial assignment of source, maintenance, and recoverability codes to spares and repair parts. NavAirSysCom is responsible for the assignment of these codes to end items of support equipment.

A brief description of the various source codes is provided in the following paragraphs.

P Series codes are assigned to materials that are purchased.

SOURCE CODE P1 is applied to items which are purchased in view of known or anticipated usage and which are impractical or uneconomical for military service manufacture.

SOURCE CODE P2 is applied to items purchased and stocked for insurance purposes because the combat or military essentiality of the end item dictates that a minimum quantity be available in the supply system.

SOURCE CODE P3 is applied to items that are purchased and stocked and, except for their deteriorative nature, would be coded P1. These items have a predicted shelf life and may require special storage conditions. Examples of P3 material would be fuel, oil, hose, seals, gaskets, etc.

SOURCE CODE P4 is applied to items that are purchased for initial issue or outfitting and are carried in stock only for subsequent issues or outfitting and not subjected to automatic replenishment.

SOURCE CODE P5 is assigned to tools and test and support equipment items that are purchased and that may be stocked for initial issue or outfitting to specific maintenance activities. Items are procured in specific quantities based on predetermined outfitting requirements and will be issued only in support of needs based on approved IMRL requirements.

SOURCE CODE P6 is applied to items purchased for anticipated or known usage and that are simple for military service manufacture or fabrication. Examples of P6 materials would be shims, washers, etc., that can be made using standard rework shop maintenance equipment.

SOURCE CODE P7 is applied to items that do not meet the criteria for stockage but that will be centrally procured by the supply system. Examples of P7 material are tools, fixtures, and equipment required by the Depot level of maintenance only. Items are not stocked or assigned a FSN.

M series codes are assigned to items that can be manufactured or fabricated with the tools and facilities available at maintenance activities within the Navy.

SOURCE CODE MO is assigned to items to be manufactured at the Organizational level of maintenance.

SOURCE CODE MF is assigned to items to be manufactured at the Intermediate level of maintenance afloat.

SOURCE CODE MH is assigned to items to be manufactured at the Intermediate level of maintenance ashore.

SOURCE CODE MG is assigned to items to be manufactured at the Intermediate levels of maintenance both ashore and afloat.

SOURCE CODE MD is assigned to items to be manufactured at the Depot level of maintenance.

A series codes are assigned to items that are not purchased but that can be assembled within the specified level of maintenance prior to installation. At least one of the items in the assembly must be a coded P item that carries an individual part number and description.

SOURCE CODE AO applies to items to be assembled at the Organizational level.

SOURCE CODE AF applies to items to be assembled at Intermediate maintenance levels afloat.

SOURCE CODE AH applies to items to be assembled at Intermediate maintenance levels ashore.

SOURCE CODE AG applies to items to be assembled at Intermediate maintenance levels both ashore and afloat.

SOURCE CODE AD applies to items to be assembled at Depot level of maintenance.

NN coded items are those items designated to be purchased locally and not stocked in the Navy supply system. They are normally readily available locally from commercial sources. An initial outfitting quantity of NN coded material may be purchased by the Inventory Control Point (ICP) for afloat and overseas activities.

X series codes are assigned to items not procured and normally not practical for stockage, maintenance, or manufacture.

SOURCE CODE XX is applied to items that are not procured or stocked because the replacement or repair of the item is impractical or uneconomical. Failure of these items will normally result in recommendations for overhaul or retirement of the end item. An example of an XX coded item would be a structural member.

SOURCE CODE X1 is applied to items not purchased or stocked because the requirements for these items will result in the use of the next higher assembly in the P series items. An example of X1 code items is a casting that requires drilling, line reaming, and press fitting of the bushings. Rather than buy the individual parts and do the machining and assembly, the assembly with bushing installed would be available and coded as a P item.

SOURCE CODE X2 is assigned to items not purchased but when required should be obtained through salvage or cannibalization. If an item is not available through these means, it may be requested through supply channels with supporting justification. Repeat requisitioning could justify a change to the P series code.

SOURCE CODE X3 is assigned to items not purchased or stocked during the initial support period but based on demand may be later procured for supply stockage during the life of the end item.

NOTE: X series codes are not assigned to tools and test and support equipment end items.

U Series codes are assigned to drawings, specifications, and data applied when not of supply or maintenance stockings significance.

SOURCE CODE UU is assigned to installation drawings, diagrams, instruction sheets, field service drawings, etc., that are identified by manufacturers' part numbers.

Source codes for parts kits and component parts of the kits are covered later in this chapter.

The applicable illustrated parts breakdowns provide ready reference for each of the codes and subcodes as required.

STEPS TO POSITIVE IDENTIFICATION

The preceding information was presented to explain data that should assist you in identifying aeronautical materials. There are many ways to use this information to obtain the same objective. The important point is to be able to select the significant information which will lead to positive identification of the material needed.

When the Part Number Is Known

When the part number is known, the federal stock number may be ascertained by reference to one of the several "part number to stock number" cross reference listings. These include the federal supply catalog MCRL, ASO catalog section C0006, which is ASO's equivalent to the MCRL, and Weapon Equipment Lists (WEL) for each aircraft type.

For example, part number 3817883-1, FSCM 18355, may be identified as FSN 1RM1680-821 5286 DA, by crossing it over in the MCRL (fig. 3-4) and then by referring to the management data list. FSCM 18355 translates to Douglas Aircraft Company, Inc., of Santa Monica, Calif. in cataloging handbook H4-2.

The part number could also have been crossed over in the C0006 ASO catalog section and then referred to ASO's List of Supporting Repair Parts, Section P2310.

And finally, if the part number has been obtained from the aircraft illustrated parts breakdown, it could be crossed over in the index of the WEL (if available) for the specific aircraft and then referred to the part 1 or 2 of the WEL (Figure 3-3) for additional information.

As indicated in the coverage on source codes, many items listed in IPB's are source coded other than "P" and will not cross over to an FSN. These are included in the WEL.

When Description Is Known

When only the description is known, a different approach is used to arrive at the FSN. There are a variety of publications used for this purpose. They are referred to as descriptive or identification type catalogs and include the following.

1. NavAir initial outfitting list, section A.
2. NavAir allowance list sections G, H, L, M, O, and P.
3. ASO's descriptive WEL's.
4. FMSO's Illustrated Shipboard Shopping Guide (ISSG).
5. Federal Supply Catalog Identification Lists.
6. General Services Administration Identification Lists.

These publications vary in format, but have one thing in common; that is, the items contained are arranged according to what they are rather than what type of aircraft or equipment they are used on. Being arranged by description means also that the items are arranged by FSC, and therefore a knowledge of FSC structure (discussed earlier in this chapter) is helpful. Of course, each of these descriptive catalogs has its own alphabetical index. In addition, Cataloging Handbook H2-3 is a comprehensive index of all descriptive characteristics arranged alphabetically and showing FSC group and class. (See fig. 3-1.)

If the descriptive name for the items cannot be found in the cataloging handbook, it is probably an obsolete or slang name. Try locating another name by reference to an unabridged dictionary or other source.

After identifying the FSC of the item in question, the FSN may be found by reference to the appropriate section of one of the descriptive type catalogs–usually the ISSG or the FSC Identification List. Figure 3-2 illustrates a page from section 5310 of the ISSG.

The allowance lists and initial outfitting lists mentioned above are covered in the next section of this chapter. They are descriptive in nature and contain only commonly used items. Stock numbers are ascertained by first looking up the item in the alphabetical index and then turning to the page and/or item indicated. (See figure 3-7.)

When Aircraft/Equipment Application is Known

When the aircraft/equipment application is known, the publication peculiar to the particular aircraft or equipment is generally the best source from which to commence identification.

The applicable IPB is a logical source. If the part number is also known, the procedure is greatly simplified. By referring to the IPB numerical index or master locator index, the illustration and descriptive data can be located. If the person requesting the material is not sufficiently familiar with the item being requested to identify it by proper nomenclature, the assistance of appropriate maintenance personnel should be requested.

WEL's are uniquely designed for use when the part number and aircraft application are known. Many items listed in the aircraft IPB and WEL are complete units of equipment containing components, subassemblies, and parts which are not listed in the IPB/WEL. In most cases there is an IPB published for these units, either as an individual publication or as part of the maintenence manual or overhaul manual for the unit. Lists of these publications are contained in the applicable IPB and WEL. NavSup publication 2002, Section VIII, parts C and D, together with NavAir 00-500A (equipment applicability list) and NavAir 00-500B (aircraft application list) may be used to locate virtually every aeronautical publication including allowance lists/outfitting lists.

Material Unidentifiable to an FSN

Every effort should be made to identify material requirements to an FSN. Frequently, however, this is not possible. Material not subjected to the federal cataloging system cannot be identified to an FSN. Occasionally, material source coded in the P series cannot be identified locally. Requirements for materials not identified to an FSN must be identified in terms familiar to supply and the prospective supplier within the supply system.

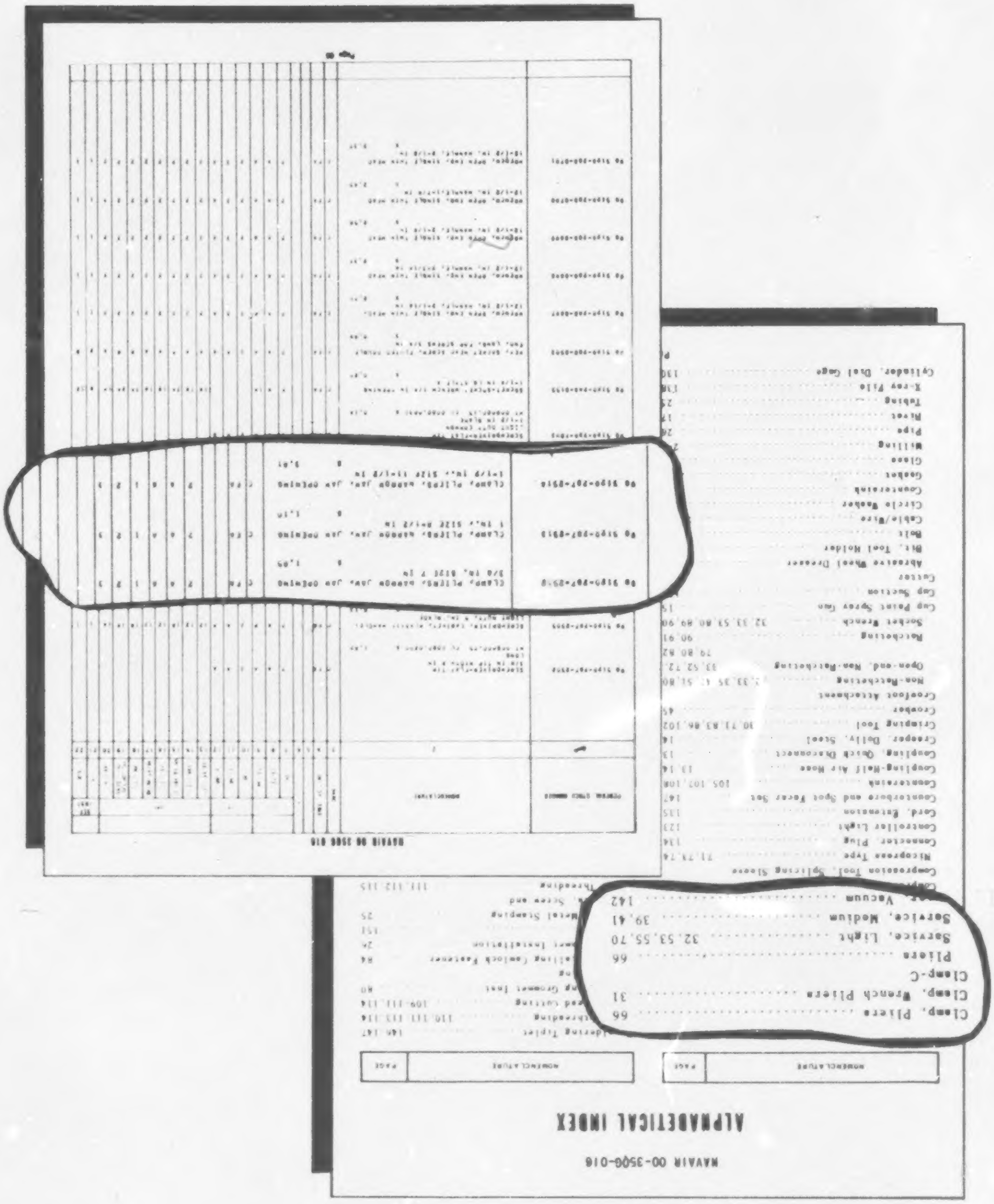
The following information should provide sufficient identification:

1. Name of the manufacturer of the item or the five-digit federal manufacturer's code.
2. Part number.
3. Nomenclature.
4. Description of specific application including model of aircraft, engine, accessory, or other end assembly on which used.
5. Source code and publication reference if available.
6. FSN or part number of the next higher assembly.

PARTS KITS

Supporting items and material for the maintenance, repair, and rework of selected repairable type items are procured, stocked, requisitioned, accounted for, and used on a kit basis as a single item. These parts kits should not be confused with Change Kits which are issued to perform a one-time modification of an item, nor with Interim Fleet Maintenance Support Kits which consist of a minimum range and quantity of parts and material to support the items until regular parts kits become available as a result of normal provisioning action.

A repair kit consists of a group of maintenance or overhaul parts that are bought, packaged, and stocklisted as a single item regardless of the supply classification of the items contained in the kit. Normally, these parts have either a very low unit cost or have a high replacement rate in overhaul or repair of the next higher assembly. Depending upon the complexity of the item to be repaired, there can be one or more kits needed for its repair. Repair



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CLAMP, PLIERS, NARROW JAW, JAW OPENING 3/8 IN, SIZE 7 IN

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CLAMP, PLIERS, NARROW JAW, JAW OPENING 1-1/2 IN., SIZE 11-1/2 IN

AM.442

Figure 3-7.—Consumable general support equipment allowance list—Section G.

kits are designed to serve three separate requirements as described in the following paragraphs.

C Kit (Cure Date or Soft Goods)

This kit provides cure-dated items such as diaphragms, packings, and O-rings. The C kit may also contain soft goods not subjected to age controls such as gaskets and seals, plus metallic items such as screws, nuts, and washers required to be removed when cure-dated or soft goods type material are replaced. When mixed categories of cure-dated parts are packaged in a single container, the controlling cure-date of the package is that of the oldest cure-dated part in the package. If cure-dated kits become overaged due to the expiration of the storage limitations, the kit is administratively disposed of as excess material.

D Kit (Overhaul)

This kit contains hard good repair parts required at the time of overhaul. This kit does not contain cure-dated parts nor any metallic item which is placed in the C kits, thus both are required at the time overhaul maintenance is being performed.

F Kit (Fleet)

This kit provides those items that are required to be replaced at Intermediate and Organizational maintenance levels. Replacement of F kit items normally does not require special tools or equipment. This type kit does not contain cure-dated parts.

Part numbers for repair kits are listed in the applicable Illustrated Parts Breakdown and, in some cases, the Maintenance Instructions Manual.

The C, D, and F kits are assigned source codes of "PC", "PD", and "PF" respectively. However, space limitations in some catalogs restrict the code designation of kits to a one-position character; therefore, it may appear as C, D, or F as appropriate. Component parts of C, D, and F kits are source coded "KC", "KD", or "KF" respectively. Component parts source coded "KB" are components of both D and F kits.

AIMD personnel involved in overhaul or repair of components should determine if parts kits are available to expedite repair or overhaul. Ordering individual items when they are available in a kit creates unnecessary paper work that is time consuming and costly.

AERONAUTICAL ALLOWANCE LISTS

This title is inclusive of publications identified as Allowance Lists (except advanced base lists), Initial Outfitting Lists, and Tables of Basic Allowances.

PURPOSE AND ORIGIN OF ALLOWANCE LISTS

Naval Air Systems Command Allowance Lists, Initial Outfitting Lists, and Tables of Basic Allowances are prepared by the NavAirSysCom or the Aviation Supply Office. In nearly all instances ASO has the responsibility for preparation, but in all cases these lists are published by the direction of and approved by the NavAirSysCom. These lists contain the following:

1. The equipment and material (both consumable and nonconsumable) necessary to outfit and maintain units of the aeronautical organization in a condition of material readiness.
2. Substantially all items used with sufficient frequency to justify their issuance to all activities maintaining aircraft or equipment for which the lists are designed.
3. Information concerning stock number, nomenclature, interchangeability, and supersedures.
4. A set of detailed instructions for the application and utilization of the publication.
5. A table of logistic data showing the total weight and cube of all material contained in the list.

In the final analysis, the equipment and spare parts listed in these publications are made available to aircraft operating and maintenance activities in accordance with assigned operational maintenance and logistics responsibilities through appropriate application of allowance lists and outfitting actions. The Aviation Supply Office has the responsibility for continually reviewing and updating allowance lists.

The Individual Material Readiness Lists, described later in this chapter, supersede several of the old allowance lists. For example, several of the allowance list sections QG, QO, QR, and QT series have been eliminated by the establishment of validated IMRL's.

Initial Outfitting Lists

Initial Outfitting Lists are publications which indicate the range and quantities of maintenance spare parts considered necessary to support various aeronautical end items. These lists contain repair parts, such as airframe parts, electronic parts, engine parts, and general aeronautical equipment. The material covered by Initial Outfitting Lists is normally retained in supply department stocks until required for issue. This allowance of material is provided to ships or activities and is firm only at the time of initial outfitting. Increases and decreases in both range and/or quantities of material are based upon usage data of each activity concerned. Each series list is designed to support an aircraft, electronic equipment, or some other aeronautical article.

Allowance lists

These are publications which indicate the range and quantities of equipment and material considered necessary for maintenance support of assigned and/or supported aircraft. Generally, these items are in-use items required for daily or continual use, such as aircraft jacks, air compressors, and avionics test equipment.

Tables of Basic Allowance

Publications listing equipment and material required by activities for performance of assigned mission are known as Tables of Basic Allowance. They contain both shop equipment and common supporting spare parts. They cover allowances of tools and equipment required for use by such activities as Fleet Marine Force squadrons and target pilotless aircraft activities.

A complete listing of Aeronautical Allowance Lists, Initial Outfitting Lists, and Tables of Basic Allowance, with NavAirSysCom publication numbers and their effective dates, is contained in NavSup Publication 2002, Section VIII, Part C.

IDENTIFICATION AND TYPES OF ALLOWANCE LISTS

Initial Outfitting Lists and Allowance Lists are identified by the publication number NavAir 00-35Q series, while Tables of Basic Allowance are identified by the publication number NavAir 00-35T series. One example of a complete publication number for each of the two types of lists is included in the section breakdown which follows.

Section A, Standard Aeronautical Material and Naval Stock Account Material

Section A covers general material such as nuts, bolts, tubing, hose, paint, and other items common to the operation of all aircraft models. Both equipage and consumable supplies are shown. Quantities of consumable supplies appearing in section A are firm for initial outfitting and may be used as a guide for replenishment until sufficient usage data are available for determining requirements.

Section B, Aircraft Maintenance Parts

Section B contains airframe, engine, and accessories maintenance parts peculiar to each type of aircraft. A separate section B is issued for each model of aircraft. Quantities of items included in this section are the amounts estimated to be required for a given period of time (normally 90 days). Quantities of items appearing in the section B are firm allowances for outfitting only, and are used as a guide for replenishment until such time that sufficient usage data are available for determining requirements. Publication number examples: NA 00-35QB-187, Initial Outfitting List for P-3A.

The QB-187 is arranged in three parts. Part 1 is a listing, in FIIN number sequence, of items that are normally stocked by the supply department supporting the particular type of aircraft. Part 2 contains a listing of items, with appropriate quantities, that should be carried in the rotatable pool. Part 3 contains a listing of those items and their appropriate quantities carried by the squadron as "in-flight maintenance kit" items. In addition there is a part number index and an FSN index.

The arrangement and content of section B IOL's will vary somewhat dependent on the type of aircraft. For example, the Section B IOL for a fighter type aircraft would not have Part 3 listed above. Instructions for use of the allowance lists are included in the introductory pages following the table of contents.

Section G, General Support Equipment For all Types, Classes, and Models of Aircraft

Section G (series) lists the quantities of handtools, handling and servicing equipment, and material which are made available for maintenance support of aircraft as may be assigned or supported.

Section H, Flight Operational Material

Section H is applicable to carrier air wings and all Navy and Marine squadrons operating aircraft or having aircraft assigned. It contains items and quantities of flight operational material considered necessary to maintain the concerned activities in a continual condition of operational readiness.

Section K, Naval Aeronautical Publications and Forms

Section K outlines the general types and classes of aeronautical technical and training publications and forms which are provided as a commissioning allowance for various Navy and Marine Corps aviation activities. It lists those publications and forms which are issued by the Deputy Chief of Naval Operations (Air) and by the Naval Air Systems Command, but does not include publications provided to aviation activities by other Navy Department systems commands and bureaus, by fleet commands, or by non-Navy offices.

Section T, Special Maintenance Support equipment

Section T is applicable to Navy and Marine aeronautical maintenance activities and lists the allowances of special support equipment required for maintenance support of assigned aircraft. A separate section T allowance is published for each manufacturer.

Section Z

Section Z includes mobile electric powerplant spare parts and equipment, and spare parts support for aircraft support equipment. Section Z also indicates the quantities of maintenance spare parts estimated (at the time of initial outfitting) to be required for aircraft support equipment for a period of 90 days.

Tables of Basic Allowance

An example of a publication number of the Tables of Basic Allowance is as follows: NA 00-35T-41, TBA for Drone Antisubmarine Helicopter Weapons System Activities and Vessels.

The foregoing section list breakdown includes only those sections of professional interest to the AM. The complete list includes allowance lists for arresting gear and catapults, photographic, aerological, etc.

ACCOUNTABILITY CODES

The accountability codes used in allowance lists and most IPB's are known as Material Accountability Recoverability Codes (MARC). MARC's are assigned only to aeronautical provisioned items to reflect the accountability, recoverability, and repair policy determined for an item of equipment of material required for the maintenance, repair, or rework of an end item. MARC is a system whereby a letter of the alphabet is used as a guidepost by personnel working with aviation material. This system helps personnel to determine the proper method of the following:

1. Requisitioning material with regard to inventory control and fiscal accounting procedures.
2. Accounting for material while in use.

3. Turn-in or disposition of material.
4. Repair or overhaul.

The following list defines the various material accountability codes:

B – Exchange Consumables

Code B is applied to items which are consumable or expendable but normally require item-for-item exchange for issue after the initial outfitting. Such items may contain precious metals, may be highly pilferable, or may be high cost items.

C – Consumables

Code C is applied to all other consumable or expendable items which do not require item-for-item exchange for replacement.

D – Equipage, Support Type

Code D is applied to end items of support equipment which are economical and practical to repair on a scheduled basis through a major rework activity. Code D items are maintained on a custodial signature basis and must be surveyed when lost or missing or when beyond economical repair. After initial outfitting Code D items require item-for-item exchange for replacement. Every effort should be made to repair Code D items locally or through fleet support activities prior to turning in the item to the supply system as non-RFI material.

E – Equipage, Locally Repairable, Support Type

Code E is applied to end items of support equipment which are to be repaired locally by the using or fleet support activity within their assigned maintenance responsibility. Code E items are maintained on a custodial signature basis when in use, require item-for-item exchange for replacement, and require surveying when lost or missing. The cognizant NavAirSysComRep may authorize repair of E items through customer service from a major rework activity in order to meet operational commitments.

L – Equipage, Locally Repairable

Code L is assigned to repairable items (except end items of support equipment) that are to be repaired locally by using activities or the intermediate support activity within their assigned maintenance responsibility. Repair parts are normally procured to support code L items. Code L items requiring repair beyond the capability of the highest level of fleet maintenance must be appropriately tagged and turned in to supply at the time of issue of the replacement item. Code L items are scrapped only by the supporting supply activity and after the AIMD has certified that the item is beyond economical repair. After initial outfitting, supply system issues of code L items are made only when exchange procedures provide for turn-in of the replaced item or when necessary to replace an item expended by approved survey.

R – Equipage

Code R is applied to repairable (except end items of support equipment) items which are economical and practical to repair on a programed basis through a major rework activity. Code R items are repaired by local activities when the extent of the required repair falls within the maintenance capability of the activity. After initial outfitting, these items are issued only on an exchange basis or when necessary to replace an item expended by approved survey.

It is anticipated that MARC's will eventually occupy the sixth position of the SM & R codes covered earlier. A few NavSup and NavAir catalogs and Illustrated Parts Breakdowns printed since 1971 have these codes in that position.

DEVIATIONS FROM ALLOWANCE LIST REQUIREMENTS

It is the policy of the NavAirSysCom to make available to each Navy activity the authorized equipment and repair parts necessary to insure operational readiness. Allowance list requirements are not mandatory and deviations are approved as pointed out in the following paragraphs.

Type, Force, and major operating commanders, or their subordinate logistics commanders, may authorize deviations from allowance list requirements including one-time in-excess issue of equipment for a requirement not considered generally applicable to other activities of the same type, or for independent operations of detached activities.

Organizational and Intermediate maintenance activities often have requirements for equipment which does not appear on existing allowance lists. In some cases the equipment is requested because it is considered superior to existing equipment or it may be the result of an entirely new requirement; that is, for rework of a component or to perform repairs or services for which no previous capability existed.

In order to assure that each request for deviation is properly reviewed and evaluated for validity and possible application to other maintenance activities, the originating activity should submit an official request to the Naval Air Systems Command Headquarters, via the chain of command (including the cognizant NavAirSysComRep). The following general procedures are followed in approval or rejection for a new piece of support equipment where no previous capability or need existed.

The request, together with complete justification, should be forwarded via the chain of command to the NavAirSysComHq. The request should not be made through supply system channels. The type commander normally identifies, on the forwarding endorsement, the Intermediate maintenance activity which will perform the equipment evaluation if different from the requesting activity.

The NavAirSysComRep normally investigates the request and indicates on the forwarding endorsement the availability of the requested equipment from existing resources. Upon review and approval, the NavAirSysComHq provides the activity concerned with the equipment. This equipment is considered a prototype and is for evaluation. No additional equipment is normally procured until the validity of the need can be determined. During the evaluation, the type commander and cognizant NavAirSysComRep performs monitoring actions and provides additional assistance as required.

The completed documentation of the evaluation is forwarded via the chain of command to the NavAirSysComHq. In the forwarding endorsement, the type commander normally suggests a criteria for allocation of equipment to other activities. Upon review of the evaluation report, the NavAirSysComHq notifies all concerned of the action taken. In case of approval, this includes ASO so appropriate action may be taken to insure updating allowance lists.

AIRCRAFT MAINTENANCE MATERIAL READINESS LIST (AMMRL) PROGRAM

This program has provided for the development of data and documentation needed to determine and establish firm support equipment requirements and inventory control of aircraft maintenance support equipment. The objective of this program is to document factual data and in-use asset information concerning the support equipment which can be used by management for the following purposes:

1. The determination and establishment of allowance requirements for support equipment at Intermediate and Organizational maintenance activities.
2. Redistribution of in-use assets.
3. To provide a base for budgeting of support equipment.
4. To measure material readiness in view of support equipment availability.

The Aircraft Maintenance Material Readiness List Program was initially established by BuWeps (now NavAir) in May, 1960, for the management of ground support equipment. Prior to that time, each fleet aircraft maintenance activity was required to consult many varied types of allowance lists covering support equipment and determine their own requirements. However, BuAer (which evolved to BuWeps and now NavAir) and ASO were determining overall fleet requirements two or three years prior to the time fleet activities determined their requirements. In most cases the BuAer/ASO determinations did not agree with those made by the fleet activities. In addition there was no provision for feedback information to BuAer and ASO of equipment that the fleet activities had on hand. There were no reliable facts on which to determine requirements and to provide budgeting information and this resulted in inaccurate procurements and distribution of support equipment assets.

These problems resulted in the development of the AMMRL program which provides a means of determining immediate and forecasted requirements for each activity.

The proper determination, budgeting, acquisition, and distribution of support equipment is the ultimate responsibility of NavAirSysCom. However, the bulk of the day-to-day work concerning the maintenance of records for equipment in-use and the location of this equipment is placed with the NavAirSysComReps LANT/PAC/Pensacola. They represent NavAir within geographical areas of responsibility. NavAirSysComRep Pensalcola's responsibility encompasses all of the naval air training activities. Some of the NavAirSysComRep's responsibilities include:

1. Scheduling, preparing, and maintaining Individual Material Readiness Lists for all Navy aircraft maintenance activities.
2. Obtaining in-use inventories and maintaining inventory data.
3. Maintaining an Application Data for Material Readiness List (ADMRL) file.
4. Furnishing consolidated inventory reports to NavAir for activities within their area of responsibility.
5. Participating in ADMRL technical review conference and AMMRL review boards.

APPLICATION DATA MATERIAL READINESS LIST (ADMRL)

This is a master list used to specify the requirements for each item of aircraft maintenance support equipment against each level of maintenance and selected ranges of each aircraft, engine, propeller, and system for which each item is needed. For example it contains allowances for all the support equipment required to support the P-3C aircraft on both the AIMD and squadron level, based on the number of aircraft (for the squadron) or the number of systems supported (for the AIMD). This data is developed primarily from Aeronautical Allowance Lists. ASO maintains the master updated ADMRL on tape and furnishes it to the NavAirSysComReps when required. ASO enters all technical changes such as changes in quantity, additions of new items, deletions, or changes of maintenance levels as approved by NavAir.

From this master file (ADMRL), the Individual Material Readiness Lists (IMRL's) are prepared. For example, when a squadron gets a completely new type of aircraft, the NavAirSysComRep can extract the allowances of support equipment required for Organizational level maintenance for that type and number of aircraft and construct an IMRL which becomes the squadron's allowance for support equipment.

INDIVIDUAL MATERIAL READINESS LIST (IMRL)

This is an allowance listing for GSE that is tailored to each organizational or intermediate maintenance activity based on the numbers and types of aircraft, aircraft engines, or aircraft systems supported.

The IMRL is printed in three basic sections which are discussed in the following paragraphs. Figure 3-8 illustrates the different sections of the IMRL.

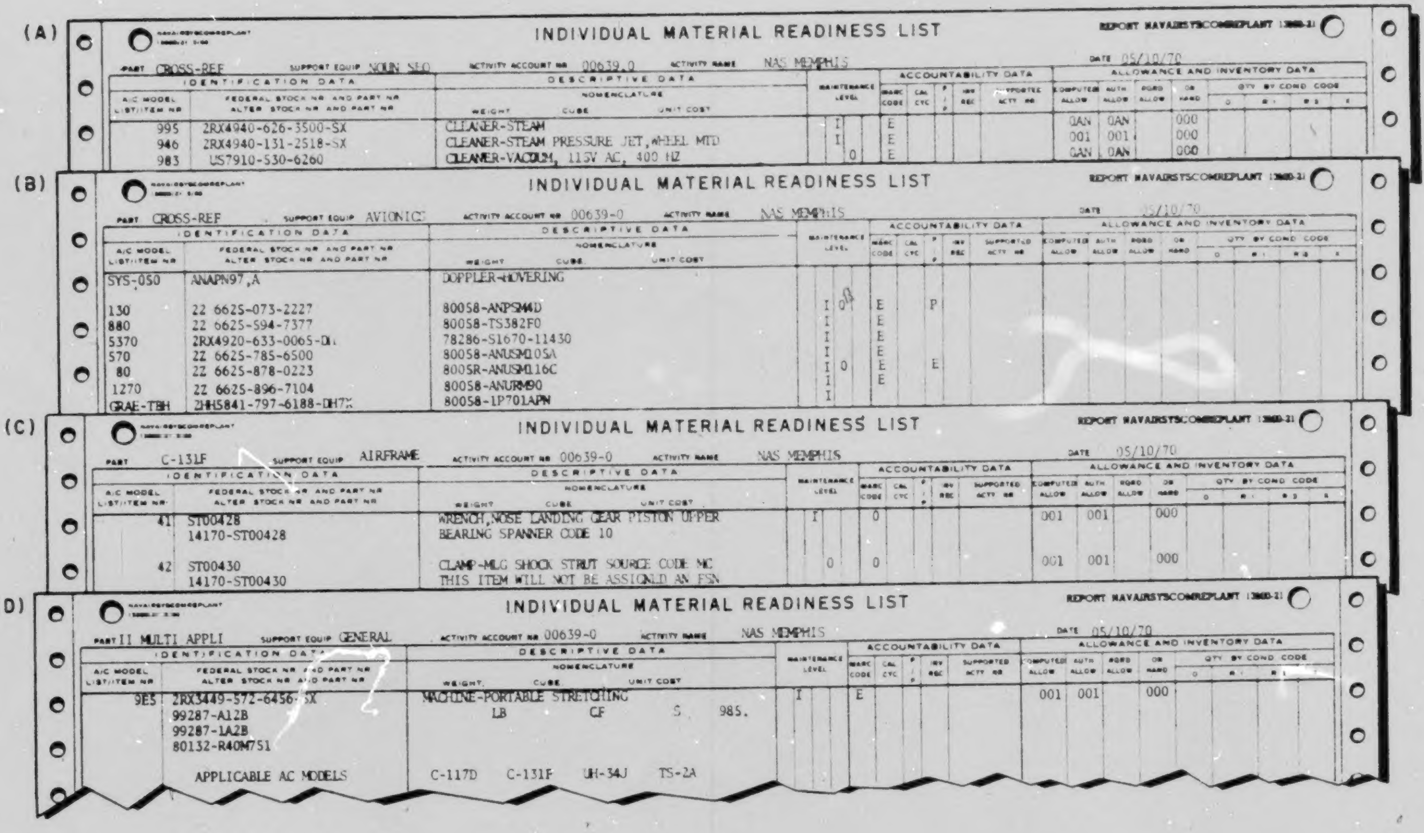
Cross Reference Section

This section is used to assist in identifying and locating material in the IMRL. It is broken down into three cross reference parts to aid in this location and identification. The parts are as follows:

FIIN SEQUENCE CROSS REFERENCE.–This part lists all prime items of equipment in FIIN sequence. The FIIN is cross referenced to a sequence number (column 1) which shows the section of the IMRL in which that particular FIIN appears.

NOUN SEQUENCE CROSS REFERENCE.–In this part is listed all prime items of equipment in alphabetical sequence by noun nomenclature. Each item in this part is also cross referenced to a sequence number column 1. An example of this part is shown in figure 3-8(A).

AVIONICS CROSS REFERENCE.–In this part is listed all of the avionics systems applicable to that particular IMRL. The major avionics systems are listed in alphabetical order and



(A)

INDIVIDUAL MATERIAL READINESS LIST

REPORT NAVAIRSYSCOMREPLANT

PART CROSS-REF SUPPORT EQUIP NOUN SEQ ACTIVITY ACCOUNT NR 00639.0 ACTIVITY NAME NAS MEMPHIS DATE 05/10/70

A/C MODEL LIST/ITEM NR	FEDERAL STOCK NR AND PART NR ALTER STOCK NR AND PART NR	NOMENCLATURE WEIGHT CUBE UNIT COST	MAINTENANCE LEVEL	MARC CODE	P/P	COMPUTER ALLOW	AUTH ALLOW	ON HAND
995	2RX4940-626-3500-SX	CLEANER-STEAM	I	E		0AN	0AN	000
946	2RX4940-131-2518-SX	CLEANER-STEAM PRESSURE JET,WHEEL MTD	I	E		001	001	000
983	US7910-530-6260	CLEANER-VACUUM, 115V AC, 400 HZ	0	E		0AN	0AN	000

(B)

INDIVIDUAL MATERIAL READINESS LIST

REPORT NAVAIRSYSCOMREPLANT

PART CROSS-REF SUPPORT EQUIP AVIONICS ACTIVITY ACCOUNT NR 00639-0 ACTIVITY NAME NAS MEMPHIS DATE 05/10/70

A/C MODEL LIST/ITEM NR	FEDERAL STOCK NR AND PART NR ALTER STOCK NR AND PART NR	NOMENCLATURE WEIGHT CUBE UNIT COST	MAINTENANCE LEVEL	MARC CODE	P/P
SYS-050	ANAPN97,A	DOPPLER-HOVERING			
130	22 6625-073-2227	80058-ANPSM4D	I 0	E	P
880	22 6625-594-7377	80058-TS382F0	I	E	
5370	2RX4920-633-0065-D	78286-S1670-11430	I	E	
570	2Z 6625-785-6500	80058-ANUSM10SA	I	E	
80	2Z 6625-878-0223	8005R-ANUSM116C	I 0	E	E
1270	2Z 6625-896-7104	80058-ANURM90	I	E	
GRAE-TBH	2HH5841-797-6188-DH7X	80058-1P701APN	I		

(C)

INDIVIDUAL MATERIAL READINESS LIST

REPORT NAVAIRSYSCOMREPLANT

PART C-131F SUPPORT EQUIP AIRFRAME ACTIVITY ACCOUNT NR 00639-0 ACTIVITY NAME NAS MEMPHIS DATE 05/10/70

A/C MODEL LIST/ITEM NR	FEDERAL STOCK NR AND PART NR ALTER STOCK NR AND PART NR	NOMENCLATURE WEIGHT CUBE UNIT COST	MAINTENANCE LEVEL	MARC CODE	COMPUTER ALLOW	AUTH ALLOW	ON HAND
41	ST00428 14170-ST00428	WRENCH,NOSE LANDING GEAR PISTON UPPER BEARING SPANNER CODE 10	I	0	001	001	000
42	ST00430 14170-ST00430	CLAMP-MLG SHOCK STRUT SOURCE CODE MC THIS ITEM WILL NOT BE ASSIGNED AN FSN	0	0	001	001	000

(D)

INDIVIDUAL MATERIAL READINESS LIST

REPORT NAVAIRSYSCOMREPLANT

PART II MULTI APPLI SUPPORT EQUIP GENERAL ACTIVITY ACCOUNT NR 00639-0 ACTIVITY NAME NAS MEMPHIS DATE 05/10/70

A/C MODEL LIST/ITEM NR	FEDERAL STOCK NR AND PART NR ALTER STOCK NR AND PART NR	NOMENCLATURE WEIGHT CUBE UNIT COST	MAINTENANCE LEVEL	MARC CODE	COMPUTER ALLOW	AUTH ALLOW	ON HAND
9E5	2RX3449-572-6456-SX 99287-A12B 99287-1A2B 80132-R40M751	MACHINE-PORTABLE STRETCHING LB CF S 985.	I	E	001	001	000
	APPLICABLE AC MODELS	C-117D C-131F UH-34J TS-2A					

AK.257

Figure 3-8.—The IMRL. (A) The noun sequence cross reference; (B) The avionics cross reference; (C) Part I, the single application section; (D) Part II, the multiple application section.

all the test equipment allowed for a particular system is shown, indented three spaces directly underneath the applicable system. An example of this part is shown in figure 3-8(B).

Single Application Section

This section is composed of items that are applicable to only one specific aircraft model. An example of this section is shown in figure 3-8(C).

Multiple Application Section

This section contains those items that apply to more than one type of aircraft. Figure 3-8(D) illustrates this section.

Definition of Columns

The following subparagraphs explain the different headings and columnar format of the IMRL pages which are illustrated in figure 3-8.

IDENTIFICATION DATA.–This heading consists of two columns. In column (1) is listed the cross reference sequence numbers. Shown in column (2) are the FSN, part number, and in the case of the single and multiple application sections, alternate items, which are indented three spaces immediately below the prime number.

DESCRIPTIVE DATA.–This heading consists only of column (3). A complete description of the IMRL item is shown; and in the case of the multiple application section, the multiple aircraft types to which the particular item applies are shown. Also provided is such information as weight, cube, and unit cost.

MAINTENANCE LEVEL.–This heading consists of columns (4) through (7). Column (4) is always left blank. Column (5) contains the letter "I" if the item applies to intermediate level maintenance. Column (6) contains the letter "O" if the item applies to organizational level maintenance. Column (7) contains the letter "T" if the item applies to transit support.

ACCOUNTABILITY DATA.–This heading includes columns (8) through (12). Column (8) contains the MARC code of the item. Column (9) contains a calibration cycle code, if applicable. Column (10) contains a pre-positioning code, if applicable. A pre-positioning code pertains to items applicable to organizational maintenance level items (code "O," column (6)) that must be checked out from the AIMD. The AIMD must account for and report these items. The following subparagraphs explain the three pre-positioning codes:

1. Code "P." This code indicates that the item is available on a subcustody basis from the supporting AIMD.
2. Code "E." This code indicates the item is available from the AIMD on an "as required" basis.
3. Code "L." This code identifies items which are issued to squadrons by the parent activity AIMD on subcustody but which may be retained by the squadron while they deploy.

Column (11) is left blank. In column (12), the activity's identification number is given.

ALLOWANCE AND INVENTORY DATA.–This heading includes columns (13) through (20). The following subparagraphs explain these columns:

1. Column (13). In this column is shown the allowance as extracted from the ADMRL.
2. Column (14), authorized allowance. This is the allowance as approved by the applicable NavAirSysComRep and Air Type Commander.
3. Column (15), required allowance. This is the quantity deemed necessary by the applicable activity. It is not a firm allowance and if it does not agree with column (14), there should be a request for a change in allowance spending.
4. Column (16), on hand. In this column is shown the total on hand quantity for all condition codes.
5. Columns (17) through (20). These columns contain the quantity of items on hand by each condition code.

MAINTENANCE OF THE IMRL

The IMRL should be continually reviewed and updated by each activity to support current and anticipated changes in aircraft maintenance support equipments requirements. Because the IMRL is continually reviewed and updated and approved by the cognizant command, it is the firm mandatory material readiness list of the activity to which it applies. Maintenance of the IMRL usually becomes the responsibility of the senior AK attached to the activity to which it applies. Maintenance of the IMRL at the maintenance activity level consists of the following:

1. Establishment of procedures for control and custody of accountable IMRL equipment.
2. Reporting all transactions involving the permanent transfer, receipt, or condition change (loss, etc.) of IMRL items via the appropriate transaction reporting form or card.
3. Conducting an annual physical inventory and submission of the annual inventory of IMRL equipment to the appropriate NavAirSysComRep.
4. Insuring that all shortages are ordered and followed up on as necessary.
5. Consolidating, preparing, and submitting requests for IMRL changes to the appropriate NavAirSysComRep.

Inventory and maintenance of an IMRL that meets the needs of the activity requires the cooperation of all maintenance supervisors. If the lack of appropriate equipment detracts from the activity's capability to perform certain maintenance tasks and the item is not on the activity's IMRL, addition of the item should be requested with adequate justification for the change in requirements. If an item on the IMRL is not required or the quantities are in excess of actual needs, again justify this fact and have the item deleted or a new allowance established so that the item may be redistributed as appropriate or dropped from the ADMRL master file. Annual physical inventories will require joint inventory by the AK maintaining the IMRL and the supervisors in charge of the IMRL equipment.

SUPPLY ACTIVITY

The mission of the supply activity is to support the operational and maintenance efforts of the activity/ship. Stocks of aviation oriented material carried are tailored and replenished to this end. Positioning, replenishment, and control of stocks of material in maintenance areas are carried out as a result of joint decisions by the Supply and Maintenance Officers concerned. They determine the range, depth, and related procedures. The Navy Maintenance and Material Management System requires that the cost of material used in maintenance be determined and accumulated in such manner and detail that weapons system costing can be measured. Usage is finely defined as to stock number, within component, within system, within equipment/weapon/aircraft, in a particular squadron, located in a specific operational area, at a definite point in time. These data are used as an inventory management tool to determine geographic and strategic distribution of stocks of material. In addition, the data will be invaluable in establishing the material portions of work standards in maintenance.

SUPPLY SUPPORT CENTER

Maintenance organizations have one point of contact with the supporting supply activity. This single supply contact point is the Supply Support Center (SSC), which responds to all material requirements of the maintenance organizations. The SSC is an internal organization of the local supply activity. It is made up of two sections—the Supply Response Section and the Component Control Section.

Supply support is available consistent with the operating hours of the maintenance activities supported. If maintenance is being performed 24 hours a day, then supply support is available 24 hours a day.

Rotatable Pool

The supply support center maintains rotatable pool material which consists of repairable ready-for-issue items reserved primarily to satisfy the requirements of Organizational level maintenance. Items maintained in the pool are capable of being repaired by the local Intermediate maintenance activity, have application relationship to weapon systems supported by local Intermediate maintenance activities, and have an average Organizational maintenance level removal rate of at least one per month. Defective components are turned in to Intermediate level maintenance for repair. The defective components repaired to an RFI condition are then returned to the rotatable pool to replace the components previously issued.

Generally, items included in a rotatable pool are repairable items of supply which are under the issue control of the local supply officer.

However, instances may occur when it is desirable to position some items or assemblies (such as a pre-soaked carburetor, built-up wheel assembly, built-up prop, etc.) in the pool for use by Organizational and Intermediate maintenance activities. Pre-positioning of items of this nature is acceptable as long as they aid in decreasing NOR time.

The local supply officer and aircraft maintenance officers concerned determine the range and quantity of each item required in the rotatable pool. Two elements used in this determination are the local repair cycle time and the local removal rate. The local repair cycle time is the average total elapsed time between removal of a component and the complete local repair of the item into an RFI condition. The local removal rate is the average number of defective components removed over a 3-month period, for which replacement RFI components were required.

After the components and the quantity of each that will be included in the pool have been determined, the supply officer publishes an official list of pool items. This listing provides a ready reference for the components carried in the pool. RFI rotatable pool items are withdrawn from the pool by the local supply officer only under the following conditions:

1. When actual usage indicates the item/quantity can no longer be justified as a reservation, and the aircraft maintenance officer concurs.
2. When requested by the aircraft maintenance officer.
3. Only as a last resort to satisfy non-local system requirements.

In order for the rotatable pool to fully serve its intended purpose there must be complete cooperation between maintenance and supply organizations. Organizational maintenance activities must expedite return of defective components to supply so that these components can be delivered to the Intermediate activity for repair. The Intermediate activity must complete repairs in an expeditious manner so that the repaired components can be returned to supply to be placed in the rotatable pool. Then, the supply organization is able to offer maximum support in the form of RFI components to insure maximum aircraft readiness.

Preexpended Bins

Many items of low dollar value are repetitively used in the aircraft maintenance program. Such items should be available to maintenance personnel with a minimum of effort. The accepted practice is to stock these repetitively used items in the immediate maintenance area (frequently in the primary using shops) in a preexpended bin. A preexpended bin is one which contains only low cost, high usage items which have already been charged to final expenditure. Establishment, maintenance, and replenishment of preexpended bins are the responsibilities of the supply support center. Preexpended material is generally defined as commonly used consumables and repair parts with a unit cost of $25 or less and a quantitative limitation of one month's expected usage.

The purpose of the preexpended bin is to facilitate the issue and accounting procedure for recurring issues of NSA and APA items of small money value. The use of preexpended material system eliminates the time required to fill out and secure authorization on a requisition, the waiting time required to process the requisition through the supply department, the posting of the individual issues to stock records, and reduces the number of transactions processed through the supply department. The preexpended bins are located where they are readily accessible to shop personnel and, when feasible, are located where they can be observed by supply personnel attached to the retail issue organization. This permits prompt recognition of any abuses to the preexpended system.

Specific items to be carried in preexpended bins are determined jointly by the supply officer and the head of the department having cognizance over the shop in which such bins are located. Such items as nuts, bolts, screws, connectors, fuses, clamps, etc. are prime examples of items included in preexpended bins.

Eligible items having a unit cost in excess of $25 may be preexpended with the approval of the commanding officer provided the total preexpended inventory at any one outlet does not exceed an estimated 30-day supply. Items contained in critical or short supply lists published by cognizant inventory managers or other competent authority may not be preexpended.

Attractive items or items considered subject to pilferage also may be preexpended; however, these items should be retained in an area under the control of the SSC.

The SSC will provide some aid so that maintenance personnel can readily determine what parts are available in pre-x. This can be accomplished by publishing a listing of those items available, by displaying them on a prominently located display board or in a display case, or any other suitable means.

Maintenance personnel should not abuse the convenience of the preexpended bins by hoarding quantities of items in excess of their needs or by removing desired items from the display board vice obtaining it from pre-x bins.

Supply Response Section (SRS)

The Supply Response Section (SRS) is responsible for preparing all necessary requisitions (DD Form 1348) and related documents required to obtain material for local maintenance use in direct support of weapon system maintenance. The maintenance organization verbally notifies the supply organization of the need of such material. When material is available locally, the time frame for processing and delivery is as follows:

Priority	Process/Delivery Time
1-3	1 hour NORS/NFE
4-8	2 hours
9-20	24 hours

The SRS is responsible for receipt, storage, and issuance of all ready-for-issue pool components. It is responsible for physical delivery of RFI material to maintenance organizations, and the pickup of defective components from the Organizational maintenance activity and subsequent delivery to the Intermediate maintenance activity. Actual maintenance personnel are not involved in the physical movement of material between organizations.

This section also performs technical research in regard to completion of requisition documents as well as determining the status of outstanding requisitions and relaying this status to the customer upon request.

The SRS accomplishes its functions through four units–the requisition control unit (RCU); the technical research unit (TRU); the stock locator unit (SLU); and the material delivery unit (MDU).

Component Control Section

The Component Control Section (CCS) maintains status records of all components being processed in the Intermediate maintenance activity and is responsible for all components assigned to the rotatable pools. CCS is divided into the following three units:

Document control unit (DCU).
Rotatable pool unit (RPU).
Supply screening unit (SSU).

DOCUMENT CONTROL UNIT.–This unit is responsible for maintaining control of components and their associated documents. This is accomplished in the following manner:

1. Maintain a document suspense file utilizing the white copy of the DD1348 received from SRS indicating that a demand for a repairable component was received.
2. Maintaining an exchange due file utilizing the yellow copy of the DD1348 received from SRS to indicate that a defective turn-in is due. This is followed up daily to insure the timely turn-in of defective components.
3. Maintain an induction return due file using the copy 2 of the MAF received from the AIMD to indicate the component has been inducted into the AIMD.
4. When processing defective components without issue of an exchange ready-for-issue component, the number 2 copy of the MAF will indicate that the component has been inducted into the AIMD as noted in step 3 above. There will be no DD1348 copies filed.

ROTATABLE POOL UNIT.–This unit is responsible for the receipt, storage, and issue of RFI pool components and the maintenance of rotatable pool stock records.

SUPPLY SCREENING UNIT.–This unit is responsible for processing all items returned from AIMD. This includes returning RFI components to the pool or the stock warehouse as applicable and processing non-RFI components to the designated overhaul point (DOP).

The SSU additionally maintains a repairable backorder file using the yellow copy of the DD 1348 for those requisitions for repairable items that could not be satisfied from on station sources (pools, stock, expeditious repair, etc.). In the event an RFI component is received from AIMD that satisfies a backorder held in the repairable backorder file, the screening unit must coordinate its action with those of SRS, CCS, and main supply and use this component to fill the outstanding requisition.

Whenever situations arise where critical RFI pool items, not-in-stock pool items, and/or not-in-stock non-pool items of a repairable type are in demand or a demand is anticipated, the CCS is held responsible for coordinating with maintenance control and the material control of the AIMD the assignment of Urgency of Need indicators. The following urgency of need codes are assigned.

1 – EXPEDITIOUS REPAIR. This is assigned for situations where supply holds a requisition that cannot be satisfied from stock or pool assets.

2 – CRITICAL POOL ITEMS. This is assigned when on-hand balance of pool items has diminished to a critical point.

3 – POOL ITEMS. This code is assigned those pool items undergoing repair other than of a critical nature. This includes High Value (HIVAC) items and Critical Aeronautical Material Equipment List (CAMEL) items that are not undergoing expeditious repair.

4 – OTHER ITEMS. This code is assigned all other repairable components that do not meet the requirements of the other three urgency of need codes.

MATERIAL CONTROL WORK CENTER

The material control work center in a maintenance activity performs a staff function, and as such, provides support and services to the production divisions. It exists for the primary purpose of insuring that maintenance requirements for parts and materials are made known to the supply organization in a timely manner in order to prevent work stoppages and grounding aircraft. Material control insures that parts and materials made available to maintenance are systematically utilized and not allowed to accumulate or to become depleted. It serves as the single point of contact within the maintenance organization for the conduct of business with the supply organization.

The material control work center provides material support to their cognizant organization by accomplishing the following general functions:

1. Pass all requirements for material required for direct support of weapon system maintenance to the SSC. A material control register is maintained for these items.
2. Prepare documents for materials required for indirect support of weapon system maintenance. Examples of materials for which documents are to be prepared are aviation fuels and lube oils, rags, and flight jackets. A separate requisition record log is maintained for these items.
3. Maintain liaison with the supporting SSC on maintenance material matters to insure that material needs of the organization are satisfied.
4. Establish delivery points for all material and insure that material received is expeditiously routed to the applicable work center.
5. Furnish technical advice and information to the supply activity on the identity and quantity of supplies, spare parts, and materials required for maintenance actions.
6. Establish procedures to insure the periodic inventory of tools and the adequate accountability of material and equipment on custody to the cognizant organization.
7. Initiate surveys in the event of loss, damage, or destruction of accountable material.
8. Keep the maintenance control work center advised of the overall supply situation as it affects the activity.
9. Perform cost and allotment record accounting, charting, and budgeting of cost applicable to the cognizant organization.
10. Monitor the operation of toolrooms and maintain an updated IMRL.
11. Maintain inventory control of authorized allowances of material.

The material control work center is responsible for the coordination of material ordering, receipt, and delivery. This is done in such a manner as to insure that the correct material is ordered and that it reaches the work center within the specified time frame.

The foregoing functions of the material control work center apply to both Organizational and Intermediate level activities. Some of the functions which are applicable to one level only are listed in the following paragraphs.

ORGANIZATIONAL LEVEL

In addition to the general functions, the material control work center in Organizational level activities is responsible for the following:

1. Verification of NORS (Not Operationally Ready Supply) and NFF (NOT Fully Equipped) requisitions and maintenance of current NORS/NFF status records.
2. Inventory of aircraft upon receipt and transfer and maintenance of inventory records.

When removed components are generated as a result of the maintenance effort, material control insures that the SSC is notified to make a pickup. These components must be accompanied by record cards and logs, when applicable, plus the number two, three, and four copy of the Maintenance Action Form.

INTERMEDIATE LEVEL

An Aeronautical Material Screening Unit (AMSU) has been established in the material control work center of Intermediate maintenance activities. This screening unit does the following:

1. Positively identifies material and determines if it is within the repair capability of the Intermediate Maintenance Activity (AIMD).
2. Insures that all required documentation is affixed to the component (that is, logs, records, MAF, etc.).
3. Notifies maintenance control of the receipt of defective components for scheduling into the AIMD.
4. Transfers the defective components to the appropriate work center when directed by maintenance control.

All components received in the AIMD material control receive screening to determine if the item is within the check, test, or repair capability of the AIMD. As a result of this screening, components requiring maintenance within the AIMD capability are reported to maintenance control as ready for induction. Items beyond AIMD capabilities are returned to the Supply Support Center with appropriate recommendations for disposition. When work on components in the AIMD has been completed, the components, together with required records, are returned to material control for appropriate routing back into the supply organization.

MATERIAL CONTROL REGISTER

Several methods are utilized by the OMA and AIMD Material Control Work Centers and the SCC to maintain records of material ordered. They are commonly referred to as the material control registers of which there are several types. There is the Organizational and Intermediate Material Control Register; a VIDS (Visual Information Display System) register; and several types of "Auto-Writer" forms which are used in lieu of registers at many shore activities.

No matter what form is used, their purpose is to record and maintain a record of material on order. Space is provided to record essential information considered necessary to monitor operating target (OPTAR) funds. This information includes part number, priority, quantity, price, date and time ordered, and date and time received. Maintenance control uses the time ordered and time received to help determine Not Operationally Ready Supply (NORS) and Not Fully Equipped (NFE) time used in fulfilling readiness reporting requirements.

At the OMA or AIMD level, when a maintenance work center places a material requirement with its respective material control, the storekeeper logs that data in the register, adds information that is his responsibility to furnish and places the order with SCC/SRS. Personnel in the SRS receive the requirement and log it in their register that is a duplicate of the OMA/AIMD register. If an auto-writer is utilized the SRS automatically receives duplicate information as the OMA/AIMD storekeeper records it on his form. These records then become a permanent record of requisitions outstanding.

Most aviation activities now employ the VIDS register. This management tool provides a graphic display of vital up-to-date information on a continuing basis.

MATERIAL REQUISITIONING

The Military Standard Requisitioning and Issue Procedure (MILSTRIP) and Uniform Material Movement and Issue Priority System (UMMIPS) were developed by the Department of Defense to provide a common supply language and more effective supply system operations within the military establishment. This system standardizes forms, formats, codes, procedures, and the priority system.

MILSTRIP employs two forms for the requisitioning and issuing of material. The Single Line Item Requisition Document (Form DD 1348) is the basic request document submitted to the applicable supply echelon for material requirements. The issue document is the Single Line Item Release/Receipt Document (Form DD 1348-1). Form DD 1348-1 is also used to return RFI material to the supply system. As previously stated, these forms will be prepared by the Supply Response Section of supply for all material requested in direct support of weapon system maintenance and by the material control work center for material requested in indirect support of weapon system maintenance.

Under the UMMIPS there is no decision to be made in assigning priorities. In addition to providing standardized criteria for assigning priorities, the system provides acceptable maximum processing times for use by supply activities in furnishing the material.

Two factors determine which of the fifteen authorized priorities should be assigned to each request for material–the force/activity designator (FAD) and the urgency of need designator (UND). A conversion table is provided by table 3-4.

The force/activity designators represent categories of activities in descending order of military importance, ranging from the combat forces under I to the miscellaneous activities under V. Every activity is assigned one of the five force/activity designations according to their military importance. These designations are as follows:

I – COMBAT–The highest order of military importance. This designator is not used in peacetime unless approved by the President or the Joint Chiefs of Staff.

II – POSITIONED–U.S. Forces positioned and maintained in a state of readiness for immediate combat or direct combat support.

III – READY–U.S. Forces maintained in a state of readiness to deploy for combat.

IV – RESERVE AND SUPPORT–U.S. active and selected reserve forces planned for employment in support of approved joint war plans. This category includes training units and units in training for scheduled deployment.

V – OTHERS–All units not otherwise assigned.

Force/activity designators are assigned by the Secretary of the Navy, the Chief of Naval Operations, and Commanders in Chief of Fleets. Authority to make assignments may be delegated to Fleet Commanders with the exception of I – COMBAT. Each activity is advised by the appropriate military commander of the assigned designator which governs the procurement of material for that activity.

Urgency of Need Designators (UND's) indicated by the capital letters A, B, and C down the left side of table 3-4 identify the existing situation caused by the particular lack of parts. Table 3-4 briefly describes the general criteria for assignment of the UND. Table 3-5 contains the detailed criteria for assignment of the appropriate UND. The urgency category is selected by the requesting activity.

If a squadron or unit has been assigned force/activity designator III and a work center supervisor determines that a part or some material is needed which if not received will impair the capability of the aircraft to perform its assigned mission, then the priority assigned must be number 6. The only other priorities available to force/activity designated III units or squadrons are 3 and 13.

The two allowable exceptions to the force/activity designator governed priority number system are indicated by the notes in Table 3-4.

MATERIAL TURN-IN

There are two main reasons for turning in material–the first and most common is the turning in of a damaged, wornout, or otherwise inoperative part in exchange for a like RFI item;

Table 3-4.—Priority designator conversion table.

URGENCY OF NEED DESIGNATOR (UND)	FORCE/ACTIVITY DESIGNATOR (FAD)				
	I	II	III	IV	V
	PRIORITY DESIGNATOR (PD)				
DESIGNATOR A Emergency requirements for nonavailable material without which the force/activity concerned is unable to perform assigned missions or tasks.	01	02	03*		
				07	08
DESIGNATOR B Requirements for nonavailable material which impairs the capability of the force/activity concerned. Missions can be performed, but with decreased operational effectivness and efficiency.	04	05	06**		
				09	10
DESIGNATOR C Requirements to replace administrative support equipment or systems not immediately essential to the mission or an aircraft or unit; routine stock replenishment; and routine scheduled maintenance/repair material.	11	12	13	14	15

NOTE: *.—A priority designator of 03 will be used for medical or disaster supplies or equipment required immediately for: prolonging life; relieving avoidable suffering; expediting recovery in case of injury, illness, or disease; or avoiding or reducing the impact of epidemics or similar potential mass illness or diseases when in professional opinion the probability is imminent. This priority designator will also be used for emergency supplies or equipment required immediately for controlling civil disturbance, disorder, or rioting.

NOTE: **.—A priority designator of 06 will be used by all activities when ordering a system identified HIVAC item unless a priority 01-05 is otherwise authorized. It will also be used for emergency supply of individual or organizational clothing required immediately to provide a minimum of essential clothing to active duty military personnel who are without the clothing required.

Table 3-5.—Urgency of need designators (UND) with definitions applicable to aviation units including AIMD's.

UND (A)

1. Emergency requirements for primary weapons, equipment, and material for immediate use without which the aircraft concerned is unable to perform assigned operational missions (NORS). (See Note 1.)

2. Items required for immediate end use in direct support of equipment essential to the operation of aircraft (e.g., ground support, firefighting, etc.) without which the aviation unit is unable to perform its mission. (See Note 1.)

3. Items required to eliminate an existing work stoppage at an intermediate maintenance activity modifying or maintaining primary aircraft or aircraft equipment.

4. Items required to eliminate an existing work stoppage at an intermediate maintenance activity performing repair and maintenance on unserviceable high value/critical item repairables.

5. Items required to effect emergency replacement or repair of essential physical facilities of an intermediate maintenance activity, without which the activity cannot carry out its mission. (See Note 1.)

6. Not Fully Equipped (NFE) requirements, only when the items are needed to return mission essential subsystems and equipments to operational status.

UND (B)

1. Items required for immediate end use, the lack of which is impairing the operational capability of the aircraft or organizational unit concerned.

2. Items required for immediate end use to effect repairs to aircraft and aircraft support equipment, without which the operational capability of the aircraft is impaired or effectiveness in accomplishing assigned missions is reduced.

3. Items required for the replacement of mission essential items on allowance/load lists where the last item has been issued out of bin to end use or the quantity remaining is less than the minimum replacement unit.

4. Material required for immediate use to repair unserviceable repairable items identified as high value items or critical items by ASO/NavAir.

5. Items required to effect replacement or repair of physical plant facilities in an intermediate maintenance activity without which the effectiveness of the facility is impaired.

6. Items required for immediate installation to effect repair or replacement of auxiliary equipment without which the effectiveness of the assigned mission is impaired.

Table 3-5. Urgency of need designators (UND) with definitions applicable to aviation units including AIMD's.—Continued

7. Required to preclude an ANTICIPATED work stoppage in performing maintenance on mission essential equipment. The work stoppage is anticipated within 12 days by CONUS activities and 17 days by overseas activities.

UND (C)

1. Items required to repair or replace administrative support equipment or systems not immediately essential to operational missions of aircraft or organizational units.

2. Items required for routine stock replenishment.

3. Items required for scheduled maintenance and repair, not immediately required.

NOTE 1: Requirements of this nature are of such a consequence as to require a report to higher authority of a degradation of the requisitioning unit's capability in accordance with established NORS procedures.

and second, returning of material for credit, such as excess material or material received in error.

When it is determined that a needed part is an exchange item, the old part should be cleaned of grease and dirt, drained, flushed, or purged as necessary before turning it in. It is the responsibility of the maintenance personnel to attach aircraft equipment condition tags directly to the repairable item. An aircraft equipment condition label is applied to the exterior of the container. All turn-in material should be returned, if practicable, in the container in which the new item was received.

Activities placing items into shipping containers are responsible for the accuracy and completeness of information on the tag and the label, including the necessary obliteration of previous markings on the container which no longer apply. The primary reason for these tags and labels is to provide a means of identification and condition without disruption of packaging or preservation. These tags and labels indicate the required disposition to those processing the material through channels.

When a defective repairable item is turned in, the following forms are required: copies two, three, and four of the multicopy Maintenance Action Form and the scheduled removal component card (SRC) when applicable. The supply department uses copy two of the MAF for bookkeeping purposes. Copies three and four of the MAF accompany the item to the Intermediate maintenance activity. When repair is completed by the AIMD, copy four of the MAF is attached to the RFI item and the item is returned to the supply system.

If material being turned in is no longer required and is RFI, a Single Line Item Release/Receipt Document (DD 1348-1) is submitted with the item. RFI means ready for issue in all respects—preservation still intact and item in original or reusable container with seals unbroken.

AERONAUTICAL MATERIAL SCREENING UNIT (AMSU)

Components that are turned into the AIMD material control area are processed through the aeronautical material screening unit to determine whether the item is within the check/test/repair capability of the AIMD, and whether such check/test/repair action is desirable.

When work on components processed and inducted into the AIMD has been completed, the component is returned to material control who, in turn, notifies the SSC that the component is ready for pickup and ultimate return to the pool or supply stock, as applicable.

Under normal circumstances, the determination of repair capability or noncapability must not exceed 24 hours for critical aeronautical material equipment list (CAMEL) items and 3 work days for other items.

CHAPTER 4

CORROSION CONTROL

Corrosion in naval aircraft is a problem requiring the continued attention of all maintenance personnel. The environment in which naval aircraft operate promotes the development of corrosion and requires that specific and continuous measures be applied for its prevention and control.

The high stress loads imposed on modern aircraft and the use of newer lightweight materials in their construction make it even more important that the structural soundness of the weapon system be maintained throughout its service life. Without anticorrosion maintenance, the aircraft would soon deteriorate and become unsafe for flight.

In the past, lack of emphasis or a complete absence of proper corrosion preventive maintenance resulted in aircraft requiring extended rework at overhaul activities. This situation had serious effects on the Navy's goal of maximum utilization of all available weapon systems and has resulted in the strict requirement for an active corrosion control program for each activity involved in maintaining naval aircraft.

CORROSION CONTROL PROGRAM

The ability to control corrosion is dependent on an active and continuous program. The senior Aviation Structural Mechanic including AME's will frequently be responsible for supervision of corrosion maintenance on a program, divisional, or shop level. In most cases the activity will have a fully implemented corrosion control program in existence, but without proper direction and motivation provided by the immediate supervisor, the program can easily become stagnant. Information on the types and nature of corrosion and general maintenance practices is provided in the Rate Training Manual, AME 3 & 2, NavTra 10309-C. In this chapter, this coverage is expanded and given direction.

ELEMENTS OF AN ACTIVE PROGRAM

A corrosion program that strives to be continuously dynamic must have coordination and motivation. Maintenance/production control is charged with the responsibility of controlling and directing all maintenance efforts within an activity; however, this responsibility is met through the use of subordinate supervisors. In pursuing a complete program of corrosion control, numerous elements must be considered; and while they are generally the concern of maintenance control, it is the unit's corrosion program supervisor that provides the necessary coordination and direction. The supervisor should be knowledgeable of the information provided in the following publications:

1. Aircraft Cleaning and Corrosion Control for Organizational and Intermediate Maintenance Levels, NavAir 01-1A-509.
2. Preservation of Naval Aircraft, NavAir 15-01-500.
3. Appropriate volume of the applicable Maintenance Instructions Manual with specific corrosion control instructions for the weapon system being supported.

While much has been done to improve the corrosion resistance of aircraft in the areas of improved materials, surface treatment, insulation, and protective finishes, corrosion program designed to provide a reasonable solution must include the following elements:

1. Thorough cleaning, preservation. and lubrication at prescribed intervals.
2. Inspection for corrosion damage and protective finish integrity on a scheduled basis.
3. Prompt treatment after detection.
4. Accurate recordkeeping and reporting of material/design deficiency.
5. Adequately trained personnel in areas of detection, treatment, and prevention.

6. Adequate materials, equipment, and technical publications.

7. Proper emphasis to the concept of all hands responsibility for corrosion control.

Training of personnel in proper methods is especially important. Occasionally, maintenance personnel not equipped to treat corroded areas cause more damage and actually aggravate the existing situation rather than control it. The unit's training syllabus should provide thorough training, and corrosion team members should receive the benefit of the special courses offered by the Naval Aviation Maintenance Training Groups and some of the Naval Air Rework Facilities. Team members should be assigned on a permanent basis with normal rotation to other billets within their rating to insure that the repetition of corrosion control tasks does not lead to program stagnation.

EVALUATING THE EFFECTIVENESS OF A CORROSION PROGRAM

The effectiveness of the corrosion program is best reflected by the condition of the weapon system during periodic inspections and can be evaluated by proper recordkeeping and reporting of treatment required on each aircraft and its components. Fullest advantage must be taken of prescribed inspections to detect incipient corrosion or deterioration, to take immediate action to prevent further deterioration, and to correct existing discrepancies.

Documentation of Treatment

All manhours expended towards the corrosion control effort must be documented on the required maintenance data collection forms. Occasionally, activities tend to overuse the Support Action Form (SAF) for this purpose. While the SAF is used to account for washing, rinsing with water, touchup painting, and all other actions taken to PREVENT corrosion on aircraft and support equipment, the Maintenance Action Form (MAF) is used to document all actions requiring the preparation, treatment, and repair of corroded items, including the painting of areas which have been treated for corrosion. The use of the MAF to document corrosion treatment actions serves to identify the work unit code (WUC) and provides a record of treatment to specific areas for future reference.

Reports

When it is considered necessary to monitor a corrosion program or investigate how much actual corrective corrosion treatment is being done by an activity, the maintenance data collection system information can be retrieved through the special Corrosion Control/Treatment Report (MDRSS-4). This report lists all support action code 040 (corrosion control) and action taken code Z (corrosion treatment) transactions for the month. The report could reveal that one aircraft or component required more attention than others during specific periods. This may be due to where the aircraft has been in relation to other squadron aircraft (deployed, etc.) or may point out a need for a better corrosion program with respect to specific portions of the aircraft, as indicated by WUC's or whenever special operations or deployments are involved.

All instances of material or design deficiency with respect to corrosion should be reported on the Unsatisfactory Material/Condition Report Form, OpNav 4790/47.

Some type commanders encourage the use of aircraft silhouette drawings similar to those illustrating the corrosion-prone areas of specific aircraft in the NavAir 01-1A-509 manual to indicate areas that have received extensive corrosion treatment. On transfer of the aircraft to Progressive Aircraft Rework (PAR) or another reporting custodian, this sheet serves to pinpoint areas that may require additional attention.

BUILT-IN ANTICORROSION PROTECTION

Aircraft design requirements emphasize the strength-to-weight ratio of the various metals used in aircraft construction and relegate corrosion resistance to secondary importance. Selection of corrosion-resistant materials would impose a weight penalty more prohibitive than the cost involved in a program of corrosion prevention by proper maintenance.

In view of the foregoing and the increasing cost of combating corrosion, aircraft manufacturers have been forced to develop and incorporate a variety of built-in anticorrosion features such as surface finishes, pretreatments, sealant and insulating materials, etc., which if properly maintained should provide acceptable corrosion resistance throughout the service life of the aircraft.

METAL FINISHING

The main purpose of metal finishing is to provide corrosion resistance; however, surface finishes may also be applied to metal parts to increase wear resistance or to provide a suitable base for paint.

In most cases the original finishes cannot be restored in the field due to nonavailability of equipment or other limitations.

Surface Preparation

Surface preparation of steel parts usually includes a cleaning treatment to remove all traces of dirt, oil, grease, oxides, and moisture. This is necessary to provide an effective bond between the metal surface and the final finish. The cleaning process may be either mechanical or chemical, depending upon the composition of the part and the choice of final finish.

Steel parts are pickled to remove scale, rust, and other foreign matter, particularly before plating.

Aluminum and magnesium parts are also cleaned in preparation for a final finish. Blast (mechanical) cleaning is not applicable to thin aluminum sheets, particularly Alclad. Steel grits are not used on aluminum or corrosion-resistant metals. All cleaning processes used on magnesium and aluminum are, in general, milder than those used for steels.

Polishing, buffing, and coloring of metal surfaces play very important parts in the finishing of metal surfaces. Polishing and buffing operations are sometimes used when preparing a metal surface for electroplating, and all three operations may be used when the metal surface requires a high-luster finish.

Electroplating

Electroplating is the process of transferring metal from one object to another by chemical and electrical means. The metal deposited is called the plate and the surface which receives the deposit is called the base. (See fig. 4-1.)

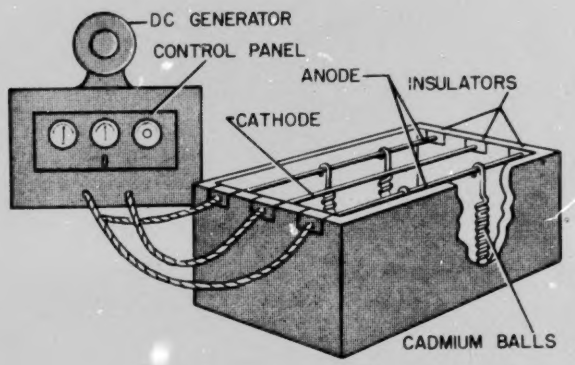


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Figure 4-1.—Electroplating equipment.

When corrosion protection is the prime reason for plating a base metal, the most common plate metals used are tin, zinc, nickel, chromium, and cadmium. Chromium and nickel are also widely used in such applications as platings on gages, dies, oleo pistons, and cylinder barrels. Resistance to tarnish is provided by gold, nickel, or chromium plating.

Anodizing

Anodizing is the artificial production of a film of hydroxide on the surface of aluminum or any of its alloys. In this process, reactions take place similar to those in electroplating, but this time the controlled oxidation is used to protect the anodic area. The deposited hydroxide film has good corrosion-resisting qualities and is required on most of the aluminum alloys used in the construction of naval aircraft. Without this protective film the aluminum would corrode rapidly when exposed to sea water or to the salty atmosphere close to the sea. This process is not a plating process and therefore has no appreciable thickness to affect the dimensions of the material. The coating is soft and easily scratched, making it necessary to use extreme caution when handling it prior to coating it with primer.

In addition to its corrosion-resisting qualities, the anodic coating is also an excellent bond for paint. In most cases, parts are routed to the paint shop for priming and painting as soon as possible after anodizing. The anodic coating is a poor conductor of electricity; therefore, if parts require bonding, the coating is removed where the bonding wire is to be attached.

Alclad surfaces to be left unpainted require no anodic treatment; however, if the Alclad surface is to be painted, it is usually anodized to provide a bond for the paint.

PROTECTION OF DISSIMILAR METAL CONTACTS

The use of several types of metals and their alloys in the construction of aircraft requires that some form of protection separator be used to minimize the reaction caused by the differences in electrical potential. Figure 4-2 lists dissimilar metal combinations which require protection separators to prevent corrosion. Separating materials are primers, coatings, plastic tape, washers, grease, or sealant, depending on metals involved.

Grouping of Metals and Alloys

The selection of dissimilar metals that are to be used in contact with each other is generally based on the following activity table:

Group I	Magnesium and its alloys.
Group II	Cadmium, zinc, and all aluminum alloys.
Group III	Iron, lead, tin, and their alloys (except stainless steels).
Group IV	Copper, chromium, nickel, silver, gold, platinum, titanium, cobalt and rhodium, stainless steels, graphite (including dry film lubricants containing graphite).

This list groups the common metals and their alloys in the order of their electrical potential. Group I materials are the most active metals and the easiest corroded. Group IV materials are the least active and require only minimum protection.

In general, whenever metals from two groups are in contact with each other, special insulation or separator material is used to assure that dissimilar metals corrosion does not take place.

Identification of Metals

In order to properly provide for dissimilar metal contact protection or treat metal surfaces, the structural mechanic needs to be able to identify the type of metal. In most cases this information can be readily obtained from repair illustrations found in the Structural Repair Manual for the weapon system being supported, Maintenance Instructions Manual, or the appropriate 03 manual for specific components. If this information is not available in reference publications, personnel involved in repairs and corrosion prevention may determine what the materials are by chemical identification methods. Chemical identification of materials will generally have more application within the Intermediate level of maintenance for identifying materials used in component manufacture and structural repair.

Contacts Not Involving Magnesium

Aluminum is protected by the application of a minimum of two coats of zinc chromate primer in addition to normal primer requirements. Primer is applied by brush or spray and allowed to air-dry 1 to 2 hours between coats.

Steel bolts, nuts, screws, and some parts of the landing gear are protected against corrosion by cadmium plating. Other steel parts including the piston section of the landing gear are protected against corrosion by chromium plating. This type of plating is also wear resistant. Figure 4-3 (A) illustrates dissimilar metals corrosion. Views (B), (C), and (D) show typical installations where this type of corrosion may exist.

Stainless steels develop their corrosion-resistant properties during fabrication by a process known as passivation, which deposits an oxide film on the surface of the metal.

Contacts Involving Magnesium

Magnesium is the most chemically active of all the metals used in aircraft construction; there-

CONTACTING METALS	5356, 5052, 5056, 6061, 6063 Aluminum Alloys	Aluminum Alloy other than 5356, 5052, 5056, 6061, 6063	Cadmium Plate	Zinc Plate	Carbon and Alloy Steels	Lead	Tin Coating	Copper and Copper Alloys	Nickel and Nickel Alloys	Titanium and Titanium Alloys	Chromium Plate	Corrosion-Resisting Steel	Magnesium Alloy
5356, 5052, 5056, 6061, 6063 Aluminum Alloys					▨	▨	▨	▨	▨	▨	▨	▨	
Aluminum Alloy other than 5356, 5052, 5056, 6061, 6063					▨	▨	▨	▨	▨	▨	▨	▨	▨
Cadmium Plate					▨	▨	▨	▨	▨	▨	▨	▨	▨
Zinc Plate					▨	▨	▨	▨	▨	▨	▨	▨	▨
Carbon and Alloy Steels	▨	▨	▨	▨				▨	▨	▨	▨	▨	▨
Lead	▨	▨	▨	▨				▨	▨	▨	▨	▨	▨
Tin Coating	▨	▨	▨	▨				▨	▨	▨	▨	▨	▨
Copper and Copper Alloys	▨	▨	▨	▨	▨	▨	▨						▨
Nickel and Nickel Alloys	▨	▨	▨	▨	▨	▨	▨						▨
Titanium and Titanium Alloys	▨	▨	▨	▨	▨	▨	▨						▨
Chromium Plate	▨	▨	▨	▨	▨	▨	▨						▨
Corrosion-Resisting Steel	▨	▨	▨	▨	▨	▨	▨						▨
Magnesium Alloy		▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	

Shaded areas indicate Dissimilar Metal Contacts

AM.443

Figure 4-2.—Dissimilar metals chart.

fore, maximum protection must be used if corrosion is to be prevented. A minimum of two coats of zinc chromate primer is applied to each surface. Next, a layer of organic adhesive or pressure-sensitive vinyl tape is applied for insulation, smoothly and firmly, and it must extend at least one-quarter of an inch beyond the faying surfaces. Sometimes more than one-quarter of an inch is required so that water will not bridge over the tape as shown in figure 4-4. Both kinds of tape will withstand temperatures up to 300°F. For temperatures between 300 and 500°F, Teflon tape is used.

Insulating washers, made from aluminum alloy with the use of a compound or adhesive backing, are often used on countersunk areas of

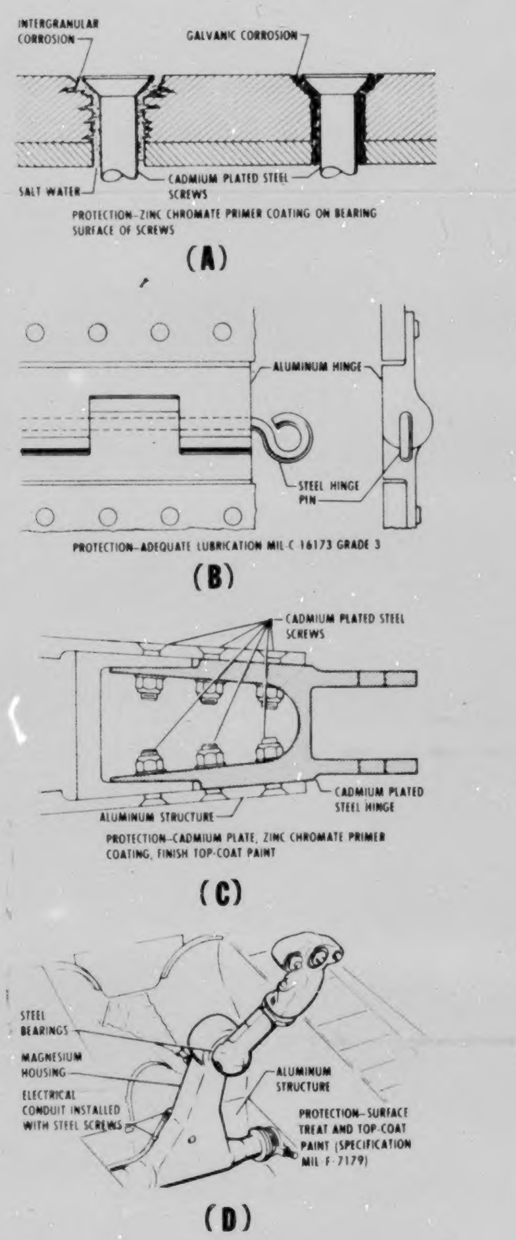

INTERGRANULAR CORROSION
GALVANIC CORROSION
SALT WATER
CADMIUM PLATED STEEL SCREWS
PROTECTION—ZINC CHROMATE PRIMER COATING ON BEARING SURFACE OF SCREWS
(A)
ALUMINUM HINGE
STEEL HINGE PIN
PROTECTION—ADEQUATE LUBRICATION MIL-C 16173 GRADE 3
(B)
CADMIUM PLATED STEEL SCREWS
CADMIUM PLATED STEEL HINGE
ALUMINUM STRUCTURE
PROTECTION—CADMIUM PLATE, ZINC CHROMATE PRIMER COATING, FINISH TOP-COAT PAINT
(C)
STEEL BEARINGS
MAGNESIUM HOUSING
ELECTRICAL CONDUIT INSTALLED WITH STEEL SCREWS
ALUMINUM STRUCTURE
PROTECTION—SURFACE TREAT AND TOP-COAT PAINT (SPECIFICATION MIL-F-7179)
(D)
AM.905

Figure 4-3.—Dissimilar metals corrosion.

magnesium panels to reduce the possibility of corrosion between the steel screws and the panels.

SEALANTS AND SEALING DEVICES

Aircraft manufacturers employ a variety of military approved sealants and sealing devices as one means to reduce corrosion in seams and around fasteners and access plates. These sealants prevent the entrance of liquids and gases and act as an electrical insulator between dissimilar metals. Personnel involved in maintaining sealed joints and devices are confronted with the task of identifying the specific type of sealant used by the manufacturer for specific applications.

The technical manual, General Use of Cements, Sealants, and Coatings, NavAir 01-1A-507, provides information on the preparation, application, and selection of the available adhesives, cements, sealants, catalysts, coatings, and hardeners for specific applications. Appropriate reference to the types of sealants used throughout each aircraft is also provided in the applicable Maintenance Instructions Manual and the Structural Repair Manuals.

Many of the materials can be used in a variety of applications and as substitutes for each other. Substitution should be based on necessity and compatability in recommended use of the sealants.

Figure 4-5 illustrates some of the more common sealant applications and sealing innovations used in modern aircraft construction.

Some of the more common sealants used in the day-to-day maintenance of sealed joints are discussed in the following paragraphs.

Temperature Resistant Sealing Compound (MIL-S-8802)

This is a synthetic base sealant with a separate catalyst. Its primary use is in sealing areas of integral fuel tanks and cell cavities subjected to temperatures from -65°F to 250°F. It is acceptable as a substitute for numerous applications such as pressure-cabin, faying-surface, and general-purpose sealant in areas that may be exposed to temperatures as high as 300°F. It is resistant to water, alcohol, oil, and gas and is

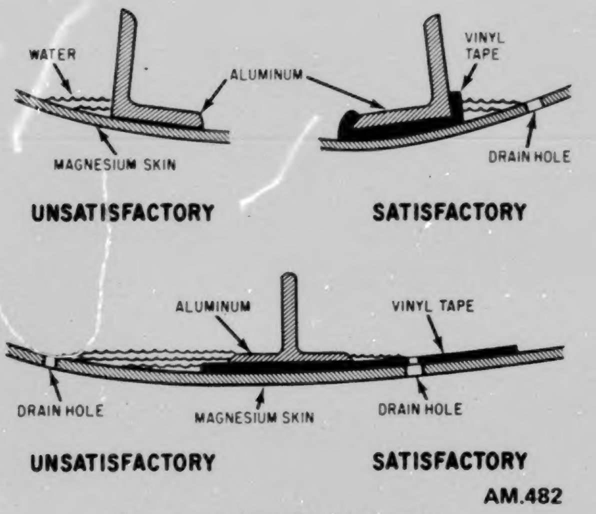


Figure 4-4.—Use of insulating tape.

available with 1/2, 2, and 4 hour's worklife. Exact mixing proportions are provided with the material. No topcoat is necessary.

Buna-N Sealant Topcoat (MIL-S-4383)

This material is used as a topcoat for protecting fuel and oil sealant, Specification MIL-S-7502, as a primer coat for other compounds, and as an adhesive for bonding gaskets, synthetic rubber, metals, glass, and plastics.

The working life is dependent on the rate of solvent evaporation, which will render it too heavy for use.

The topcoat can be brushed on at package consistency or thinned according to the manufacturer's specifications for dip or spray application. It dries tack free in 2 hours and is fully cured after 24 hours.

Sealant Repair Procedures

The sealed integrity of the aircraft must be maintained throughout its service life. Removal of sealed panels, fasteners, exposure to harsh cleaning solvents, etc., over prolonged periods will eventually cause deterioration of sealant. Recoating or complete replacement of sealant may be required. The following paragraphs explain some of the general practices and considerations used in maintaining sealed joints.

SAFETY PRECAUTIONS.—When effecting sealant repairs, the following precautions should be adhered to:

1. Avoid skin contact with organic sealants and the cleaning compounds used in sealing preparations. Rubber gloves and goggles should be worn while working with solutions. If a solution accidentally contacts the skin or eyes, it should be washed off immediately with large quantities of clear water. Report to sick bay in all cases when the eyes are affected or if the skin is burned.
2. When effecting sealant repairs of any kind, the aircraft must be grounded, electrical equipment rendered inoperative, and any external power source disconnected.
3. Use explosion-proof lights and spark-proof tools.
4. If sealants and solvents necessary for sealant repair are used in a closed space, forced ventilation must be provided.
5. When removing the old sealant from the aircraft do not use metallic scrapers. Metallic scrapers would present the hazard of scratching or gouging the structure, resulting in stress concentrations and eventual cracking, togehter with the possibility of damage to corrosion-protective coatings. Phenolic or micarta scrapers must always be used and kept reasonably sharp for the utmost efficiency.
6. When repairing damaged sealants, clean outer clothing and head coverings should be worn. Natural oils of the skin and hair will prevent full adhesion of new sealant when brushed even lightly over an area which has been cleaned for sealant application.
7. Use only clean, dry cloths or rags where cleaning cloths are specified.
8. When pressure testing the cockpit area or the integral wing tanks for initial inspection of leakage due to sealant or structural damage, or for final testing after completion of repairs, it is mandatory that air pressures be kept within the specified limitations of each testing procedure. Failure to adhere to the specified pressure limits may result in damage or over-stress and subsequent structural failure.

STORAGE AND HANDLING OF SEALING MATERIALS.—Most sealants have a shelf life of from 6 to 9 months; therefore, care should be exercised in estimating the amount to be procured. In order to obtain maximum shelf life, the storage area should be cool, dry, and preferably dark and fireproof. Ample fire extinguishers must be provided for the storage area.

Some sealing materials are procured in matched lots of base sealing compounds and accelerators. These materials should be stored in such a manner to permit the use of the matched lots of base material and accelerator as a unit.

Sealant material should be stored and issued in the order of the date of manufacture shown on the labels. Materials bearing the oldest date should be issued first. In the event that the date of manufacture is not shown on the container, the date of receipt should be considered as the approximate date of manufacture for the purposes of storage and issue.

PREPARATION OF SEALANTS.—The installation of sealing compounds is dependent upon proper handling, weighing, mixing, storing, application, and curing of the sealant compounds. Disregard or omission of any one of the required stages of sealant installation may result in defective sealants and subsequent defective sealing of aircraft components.

Most sealants consist of two or more ingredients properly proportioned and compounded to obtain the best results. Some materials are ready for use as packaged while others will require mixing before application.

One-Part Sealants.—One-part sealants are prepared by the manufacturer and are ready for application as packaged. However, the consistency of some of these compounds may be altered for the purpose of satisfying a particular method of application. If thinning is desired, the thinner recommended by the sealant manufacturer should be used.

Two-Part Sealants.—Two-part sealants are compounds requiring separate packaging, in order to prevent cure prior to application. These parts are identified as base sealing compound and accelerator. The accelerator and the base sealing compound are supplied separately. Any alteration of the prescribed ratios will reduce the quality of the material.

Before weighing the sealant materials, both the base sealant compound and the accelerator should be thoroughly stirred. Accelerator which is dried out, lumpy, or flaky should not be used.

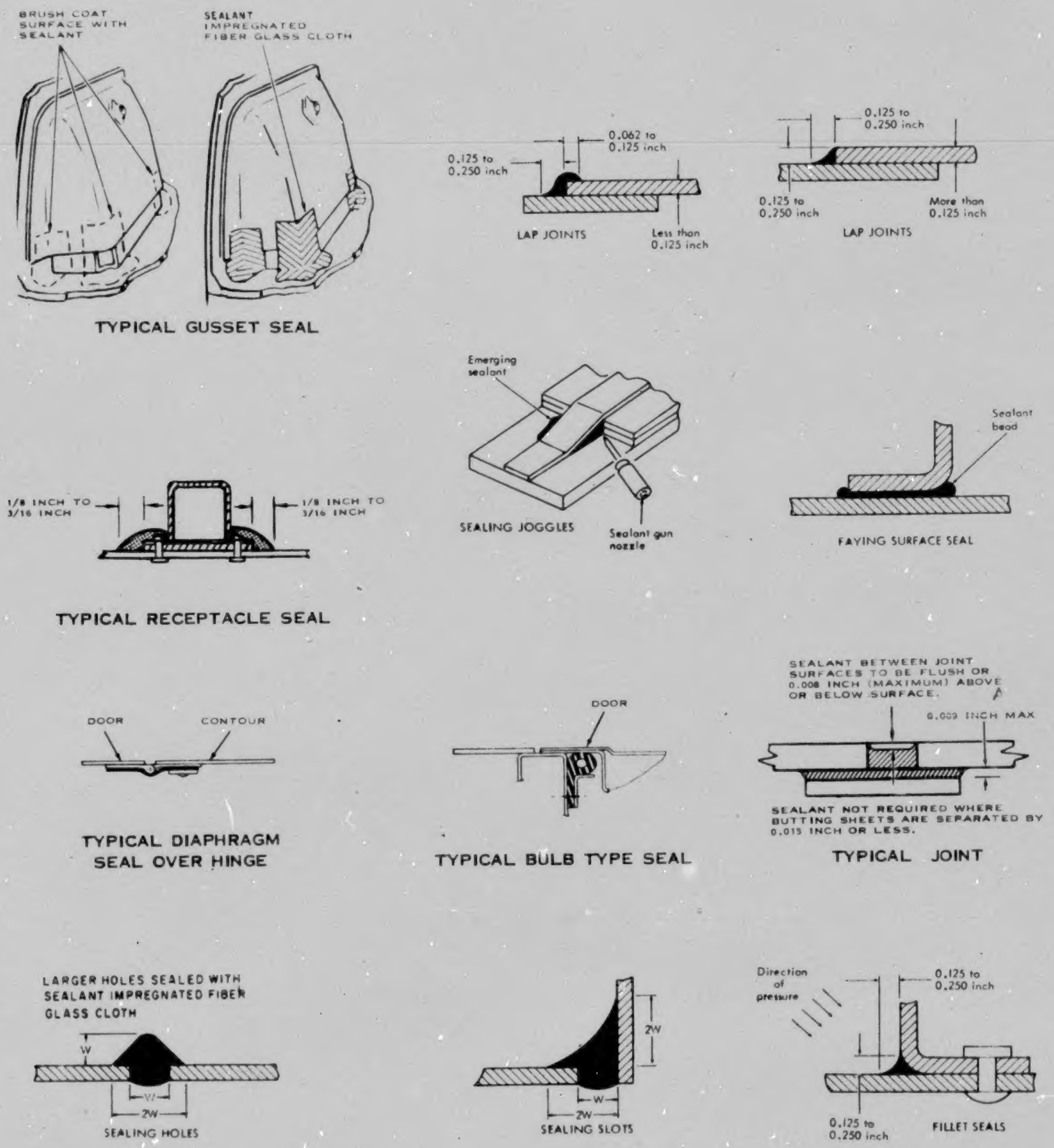
All sealant material should be carefully weighed in accordance with the sealant manufacturer's recommendations. Weighing of sealant material is usually accomplished with a balance scale equipped with weights specially prepared for various quantities of sealant and accelerator.

NOTE: Preweighed sealant kits do not require weighing of the sealant and accelerator before mixing when the entire quantity is to be mixed and used.

After the proper amount of base sealant compound and accelerator has been determined, add the accelerator to the base sealant compound. Immediately after adding the accelerator, thoroughly mix the two parts by stirring or folding, depending on the consistency of the material. The material should be mixed carefully to prevent entrapment of air in the mixture.

APPLICATION OF SEALANTS.—Figure 4-6 illustrates the sealant gun normally used in the general application of sealants. A list of restrictions applying to all sealant applications is covered in Chapter 4 of the AME 3 & 2 Rate Training Manual and is provided in most Structural Repair Manuals for specific aircraft. Cleanliness of the surface is of prime importance to assure good adhesion. Figure 4-7 illustates some typical sealant removal, trimming, and fillet fairing tools.

Form-in-Place Seals.—Form-in-place seals are used to prevent water entry around covers and removable skin panels. Sealant repair of these seals is accomplished in the following manner. Remove the old seal, using a sharp tool such as that illustrated in figure 4-7. If the condition of the old seal permits, the sealant can be sanded and recoated. Clean the surface, holes, and crevices with a vacuum cleaner or low-pressure dry air, then wipe with a suitable solvent such as toluene. Around Stat-O-Seals and O-rings use methyl isobutyl ketone to prevent damage. Apply masking tape to the outer edges or the inside surface of the door as illustrated in figure 4-8 and dependent on whether the seal is being placed on the door or the frame. Next, spread a thin coating of general-purpose aircraft grease, polyvinyl alcohol, or similar parting agent to the


BRUSH COAT SURFACE WITH SEALANT
SEALANT IMPREGNATED FIBER GLASS CLOTH
TYPICAL GUSSET SEAL
0.062 to 0.125 inch
0.125 to 0.250 inch
LAP JOINTS
Less than 0.125 inch
0.125 to 0.250 inch
0.125 to 0.250 inch
More than 0.125 inch
LAP JOINTS
Emerging sealant
SEALING JOGGLES
Sealant gun nozzle
Sealant bead
FAYING SURFACE SEAL
1/8 INCH TO 3/16 INCH
1/8 INCH TO 3/16 INCH
TYPICAL RECEPTACLE SEAL
SEALANT BETWEEN JOINT SURFACES TO BE FLUSH OR 0.008 INCH (MAXIMUM) ABOVE OR BELOW SURFACE.
0.009 INCH MAX
SEALANT NOT REQUIRED WHERE BUTTING SHEETS ARE SEPARATED BY 0.015 INCH OR LESS.
DOOR
CONTOUR
TYPICAL DIAPHRAGM SEAL OVER HINGE
DOOR
TYPICAL BULB TYPE SEAL
TYPICAL JOINT
LARGER HOLES SEALED WITH SEALANT IMPREGNATED FIBER GLASS CLOTH
W
W
2W
SEALING HOLES
2W
W
2W
SEALING SLOTS
Direction of pressure
0.125 to 0.250 inch
0.125 to 0.250 inch
FILLET SEALS

AM.906

Figure 4-5.—Typical sealant application.

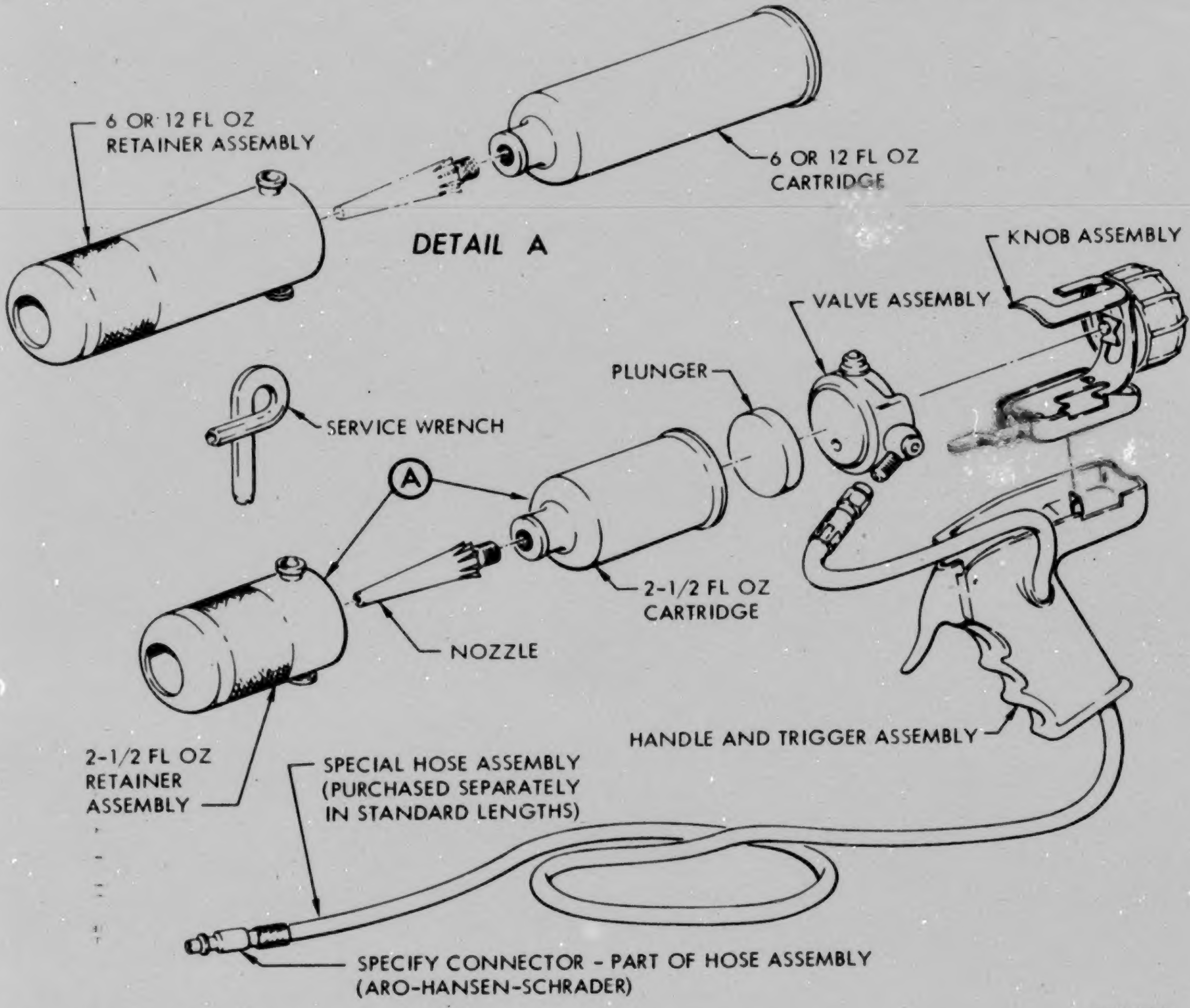
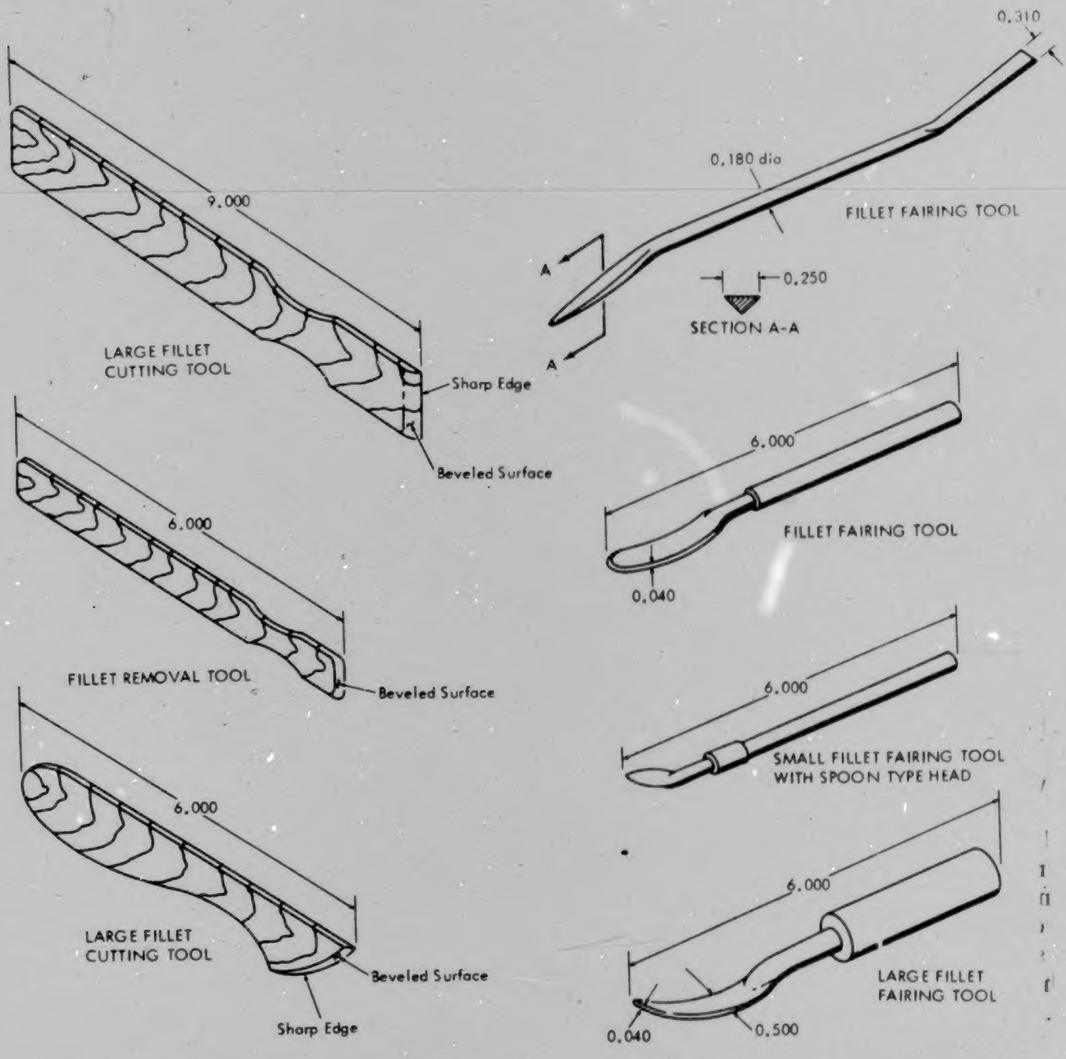

6 OR 12 FL OZ RETAINER ASSEMBLY
6 OR 12 FL OZ CARTRIDGE
DETAIL A
KNOB ASSEMBLY
VALVE ASSEMBLY
PLUNGER
SERVICE WRENCH
A
2-1/2 FL OZ CARTRIDGE
NOZZLE
HANDLE AND TRIGGER ASSEMBLY
2-1/2 FL OZ RETAINER ASSEMBLY
SPECIAL HOSE ASSEMBLY (PURCHASED SEPARATELY IN STANDARD LENGTHS)
SPECIFY CONNECTOR - PART OF HOSE ASSEMBLY (ARO-HANSEN-SCHRADER)
AM.579

Figure 4-6.—Sealant gun.

rim of the panel, fastener holes, and the door, panel, or frame where sealant is not to be applied. Using a sealant gun, apply a bead of sealant approximately 1/8 inch in diameter between the edge of the door or panel and fasteners; or if applied to the frame, position the bead no more than 1/4 inch from where the door edge fits against the frame. Spread the sealant around the door, panel, or frame and around fasteners and holes. Close the door or install the panel and assure that sealant protrudes from the space between the surfaces. If the protruding sealant is not continuous around the panel or door, it must be removed and resealed. Allow the sealant to cure and then trim the excess sealant. All excess material used as a parting agent can be removed with a suitable solvent, and a light coat reapplied to the seal to accommodate later removal of the panel or opening of the door.


0.310
9.000
0.180 dia
FILLET FAIRING TOOL
A
0.250
SECTION A-A
A
LARGE FILLET CUTTING TOOL
Sharp Edge
Beveled Surface
6.000
6.000
FILLET FAIRING TOOL
0.040
FILLET REMOVAL TOOL
Beveled Surface
6.000
SMALL FILLET FAIRING TOOL WITH SPOON TYPE HEAD
6.000
6.000
LARGE FILLET CUTTING TOOL
Beveled Surface
Sharp Edge
LARGE FILLET FAIRING TOOL
0.040
0.500

NOTES:

1. All dimensions are in inches and are approximate.
2. The fillet cutting and removal tools may be fabricated from Hardwood, Plexiglas or 2024-T3 Aluminum alloy.
3. The fillet fairing tools may be fabricated from 0.250 or 0.500 inch Rod. Bronze or Steel welding rod may be used.

AM.908

Figure 4-7.—Sealant removal, trimming, and cutting tools.

Masking tape applied around sealed or filled seams should be removed while the sealant is still wet or in a semicured condition. This method makes a smoother seam edge.

After all seams and joints are dried tack free, they may be trimmed as necessary with the sealant removal tool, illustrated in figure 4-7, or by using an air-powered drill motor with a locally manufactured sealant fairing tool similar to that shown in figure 4-9.

Some form-in-place seals are made by bonding closed cell sponge rubber to the inner side of doors or covers with an adhesive. Whenever the door is removed, the seal must be replaced regardless of its condition. The types of seals and sealants used for form-in-place type seals will vary with the particular aircraft manufacturer, so it is necessary that the Structural Repair Manual for each aircraft be consulted before commencing any repair action.

Sealant Strips Over Fasteners.—Sealant strips are being used by many aircraft manufacturers to improve the corrosion resistance of wings and stabilizer sections. The rows of exposed fastener heads are stripped of their final finishes and cleaned with a suitable solvent such as methyl isobutyl ketone. Before the cleaner dries, it is wiped with a clean dry cloth, then allowed to air dry. A single thickness strip of masking tape is applied 3/16 to 1/4 inch from each side of fastener head rows. The gap is filled with sealant conforming to MIL-S-8802, until all fasteners are covered. A spreading tool is used to remove excess sealant, leaving a thin film of sealant at least the thickness of the masking tape (0.008 to 0.015). The masking tape strips are removed before the sealant sets to allow the edges to flow and fair aerodynamically. The sealant is allowed to cure for at least 24 hours prior to the application of any final finishes.

CURING OF SEALANTS.—The curing rate of mixed sealants varies with the changes in temperature and humidity. Curing of sealants will be extremely slow if the temperature does not exceed 60°F. A temperature of 77°F with 50 percent relative humidity is considered the ideal condition for curing most sealants.

Curing may be accelerated by increasing the temperature, but in no case should the temperature be allowed to exceed 120°F during the curing cycle. Heat may be applied by using infrared lamps or heated, dry, clean air.

Heat should not be applied to any faying surface sealant installation until all work is completed. All faying surface applications must have all attachments, permanent or temporary, completed within the application time limitations of the sealant.

Sealant must be cured to a tack-free condition before applying brush top coatings. (Tack-free consistency is the point at which a sheet of cellopane pressed onto the sealant will no longer adhere.)

IN-SERVICE CORROSION PREVENTION

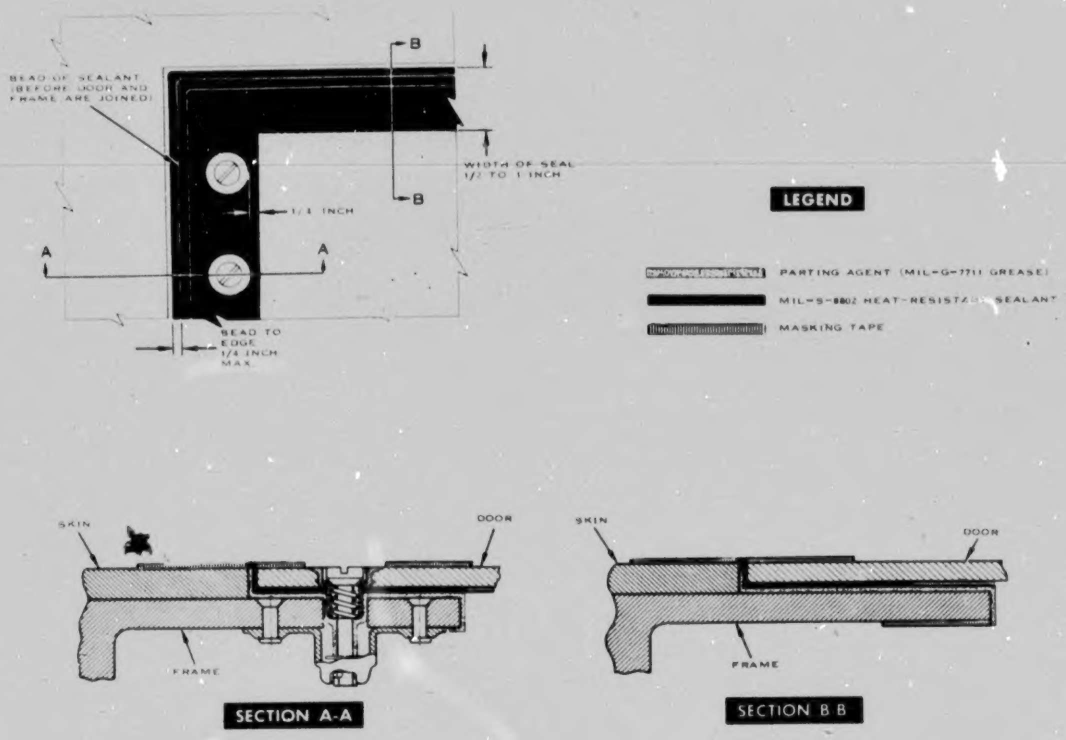
In-service corrosion prevention refers to the complete program of preventive maintenance directed towards corrosion control. It includes aircraft cleaning, lubrication, inspection and evaluation of damage, treatment, and preservation.

DAILY MAINTENANCE PROCEDURES

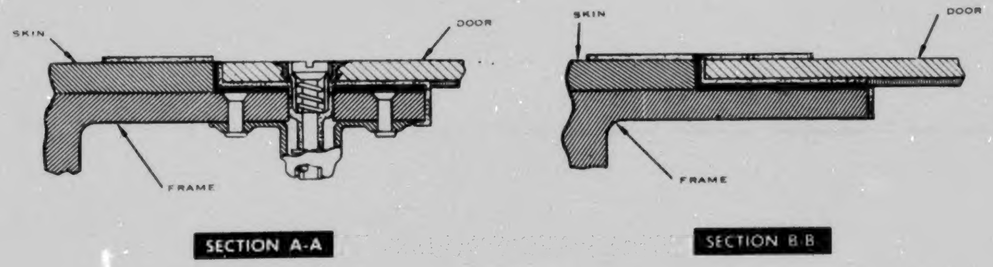
Daily maintenance effort directed towards the prevention of corrosion must necessarily be continuous and receive more emphasis during periods when the aircraft are exposed to the severe operating conditions of shipboard operations, overwater flights, and similar environmental conditions.

Failure of operating activities to properly stress aircraft cleanliness and in-service preservation can result in serious deterioration of the aircraft and develop into a safety of flight situation. It also produces additional workload requirements on rework activities and subsequent aircraft custodians.

Consistent observation by supervisory personnel of the manner in which their subordinates carry out day-to-day maintenance will occasionally reveal work habits which contribute to the susceptibility of the aircraft to its environment by destroying protective finishes. Foot traffic on aircraft surfaces, carelessness in handling tools, parts, and support equipment, plus the failure to utilize available protective pads result in many manhours spent in restoring protective finishes and corrosion removal. Insistence on good work


BEAD OF SEALANT (BEFORE DOOR AND FRAME ARE JOINED)
B
B
WIDTH OF SEAL 1/2 TO 1 INCH
1/4 INCH
A
A
BEAD TO EDGE 1/4 INCH MAX
LEGEND
PARTING AGENT (MIL-G-7711 GREASE)
MIL-S-8802 HEAT-RESISTANT SEALANT
MASKING TAPE
SKIN
DOOR
FRAME
SECTION A-A
SKIN
DOOR
FRAME
SECTION B-B

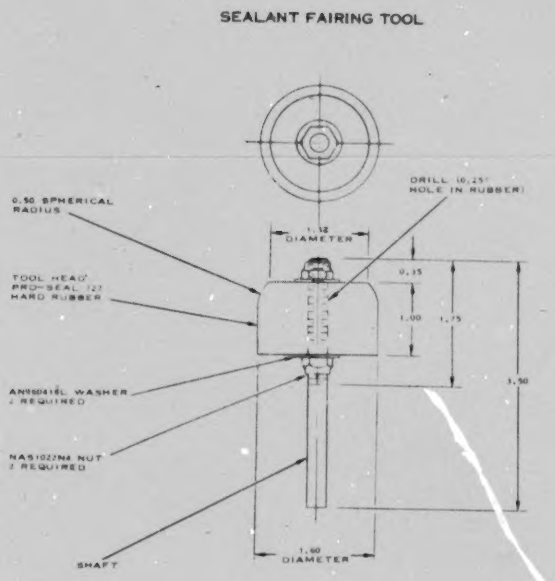
SEALANT APPLIED TO DOOR


SKIN
DOOR
FRAME
SECTION A-A
SKIN
DOOR
FRAME
SECTION B-B

SEALANT APPLIED TO FRAME

AM.909

Figure 4-8.—Application of form-in-place door seals.



NOTES

1. FABRICATE SHAFT FROM 1/4-INCH DIAMETER 4130 STEEL BAR, MIL-S-6758, CONDITION D-4.
2. CUT 1/4-28UNF-3A THREADS ON SHAFT IN ACCORDANCE WITH MIL-S-7742. SHAFT DIAMETER IN THREAD AREA IS 0.2500 (+0.000, - 0.0065).
3. FORM TOOL HEAD BY CURING SYNTHETIC RUBBER POLYETHYLENE TUBE OR MOLD.
4. USE TOOL IN 1/4-INCH DRILL MOTOR.
5. ALL DIMENSIONS SHOWN ARE IN INCHES.

AM.910

Figure 4-9.—Sealant fairing tool.

habits always requires continued attention. Conscientious attention to cleaning, ground handling, use of protective pads, covers, and shrouds, and prompt attention to corrosion maintenance discrepancies will result in minimum opportunity for corrosion to take place.

CLEANING REQUIREMENTS AND PROCEDURES

Aircraft cleaning is the first step in the process for prevention of corrosion of aircraft. The general appearance of the aircraft is secondary in importance to the removal of corrosive agents. Not only does cleaning minimize the effects of corrosion caused by contaminants, it also retains aerodynamic efficiency and safety, reduces fire hazards, and helps keep the white coating areas clean enough to serve its purpose of reflecting visible and infrared energy.

Frequency of cleaning will depend upon the type of aircraft and its environment. Cleaning, lubrication, and preservation must be accomplished in accordance with Special or Conditional Maintenance Requirements Cards. Specific effort should be made to clean all corrosion-prone areas at the previously prescribed intervals if unusual conditions complete aircraft cleaning. Magnesium parts, ultrahigh-strength steel parts, engine, rocket and missile exhaust impingement areas, piano hinges, and control cables must be cleaned and inspected on a scheduled basis. In addition, daily cleaning or wipedown is required on all exposed unpainted surfaces such as landing gear struts, actuating rods of hydraulic cylinders, etc. The necessity for additional cleaning is indicated by the evidence of appreciable soil accumulation, excessive oil and exhaust gas deposits, salt deposits, and similar surface conditions. Presence of spilled electrolyte and deposits around battery terminals and general area should get immediate attention. Cleaning is always required after exposure to fire extinguishing materials, severe weather conditions, salt water spray, and low-level ocean flight. After repairs or service, localized cleaning to remove all oil stains, smudges, boot, hand, and finger marks is considered a good maintenance practice and part of the overall job.

In preparing the aircraft for cleaning, all access doors, canopy, air ducts, etc., should be closed or plugged to prevent water entry and damage. Aircraft heated by the sun or as a result of operation should be cooled with fresh water prior to starting cleaning operations. Elevated temperatures can cause rapid solvent evaporation and concentrated solutions which could damage aircraft surfaces. Insure that all drain holes are clear to prevent the entrapment of cleaning solutions and water.

Most aircraft low-point drains are relatively small holes which are easily blocked with dirt, grease, chips of paint, metal shavings, etc. These drains must be checked daily to insure that no obstructions are present which will prevent free drainage. They can be kept clear by inserting a probe into the opening. If adequate drain holes are not provided, submit an Unsatisfactory Material/Condition Report (UR).

The Aircraft Cleaning and Corrosion Control Manual (NavAir 01-1A-509) provides a complete listing of recommended cleaning materials, types of soil they will effectively remove, and recommended procedures for their use.

All personnel involved in the cleaning of aircraft should have a thorough knowledge of the materials, methods, and procedures used to remove soils from all exposed surfaces.

Suitable equipment should be used and the correct method and sequence of procedure in applying the cleaning agents should be followed. Strict safety regulations and health precautions should be followed in the use and handling of the various cleaning compounds.

NOTE: Aircraft should be provided with a good electrical ground as cleaning operations produce static electrical charges, creating a fire hazard.

The cleaning procedure used should be the mildest method which will produce the desired result. Harsh cleaning methods such as live steam cleaning will remove soils and residual greases, but will also erode paint and damage electrical insulation. High velocity jets can drive soil and corrosive materials into openings and crevices from which they cannot be removed. For this reason, steam cleaning is no longer authorized for use at the Intermediate or Organizational levels of maintenance.

Difficulties will be avoided by removing soils as soon as possible. The longer a soil remains in place, the more difficult it is to remove, especially in high temperature areas.

Only the cleaning materials approved by the Naval Air Systems Command can be used on naval aircraft. These cleaners have been approved only after undergoing extensive laboratory tests to prove their ability to clean effectively when mixed at the prescribed concentrations without damaging any of the metallic or nonmetallic materials used in the aircraft.

The approved cleaning materials are, for the most part, nonetching alkaline (soluble and capable of neutralizing acids) type cleaners. Acid cleaners are not approved for use at the Intermediate or Organizational maintenance levels. Even when used in the proper concentrations, caution must be exercised not to trap any of the cleaning solution in holes, crevices, or overlapping joints, as failure to remove these residual solutions will allow corrosion to occur.

Engine Cleaning and Preservation Procedures (Salt Deposits)

Corrosion team members may be required to assist in performing engine wash and corrosion preventive treatment on certain aircraft engines. Protective coatings on internal parts are subject to erosion by the natural ingestion of abrasive particles such as sand and dirt until the base metal is eventually exposed. Highly stressed areas exposed to corrosion pitting may fail prematurely. Experience has shown that, to maintain top engine performance in all operational environments, the accumulated dirt and salt deposits must be removed.

The differences in engines determine the variations in engine cleaning and preservation procedures. Some engines cannot be washed internally because the water would enter the various systems through their seals. Subsequent engine operation would boil the water away and leave chloride deposits which could rust pumps, bearings, gearboxes, etc., as well as contaminate the lubricants.

Maintenance personnel should always refer to the applicable Maintenance Instructions Manual before washing any engine. Some jet engines such as the T-58/J-79 require washing followed by spraying with a preservative (Rust-Lick #606) into the compressor inlet under the following circumstances:

NOTE: Rust-Lick #606 is a preservative material used specifically for internal engine corrosion prevention.

1. Whenever engine performance deteriorates below allowable limits.
2. Visual inspection reveals a buildup of carbon, dirt, or oil-based deposits on the compressor blades or vanes.
3. Whenever engines have been operated from bases within 10 miles of salt water.
4. All engines operated below 500 feet over salt water and engines that are known to have ingested salt water during hover operations below 30 feet.

Engines that have ingested salt water or mist directly into the compressor inlet should be water washed and sprayed with preservative after the last flight of the day.

The washing and preservation procedure generally calls for wiping any salt deposits from the compressor inlet and exterior surfaces with a clean water-dampened cloth. The engine is allowed to cool for a specified length of time dependent on the engine. Water is then sprayed into the inlet while motoring the engine. Following the wash with fresh water, excess moisture is wiped from the surrounding skin area and other accessible areas where it may have accumulated. The engine is started and run at ground idle to dry out residual water inside the engine. The engine is allowed to cool again and is then sprayed in much the same manner with Rust-Lick preservative for 3 - 5 seconds or until the preservative is seen coming from the exhaust casing.

The engine cannot be operated until the Rust-Lick is washed from the compressor by repeating the washing procedure. In colder weather, washing may be accomplished using a mixture of 40 percent methanol and 60 percent water in lieu of plain water. The mixture must be thoroughly agitated prior to spraying. Methanol is flammable and should not be used if the ambient temperature is above 40°F. Its vapor is extremely toxic. If swallowed it can be fatal or cause blindness. Avoid prolonged breathing of vapors and keep it away from open flames.

The Cleaning and Corrosion Manual illustrates a jet engine corrosion control cart which provides a safe and convenient method of applying fresh water and preservative compounds to the compressor inlet in the form of a low-pressure spray. Some maintenance manuals recommend special nozzle rings or spray loops to provide even spray applications.

Postcleaning Requirements

Postcleaning maintenance serves to return the aircraft to a flight ready condition. Cleaning materials, steam from the launching catapults aboard ship, and weather conditions remove lubricants that are essential to safe flight.

Lubrication performs the dual purpose of preventing wear between moving parts and acting as a barrier against corrosive agents by filling the air space between parts and displacing water. The lubrication requirements contained in Maintenance Instructions and on the Maintenance Requirements Cards are usually adequate to prevent corrosion of most lubricated surfaces under normal conditions ashore. However, these requirements should be stepped up, or the lubrication interval shortened, when operating aboard ship or whenever severe operating conditions indicate such action is necessary.

All exposed areas must be lubricated after cleaning. Zerk fitting lubrication points on landing gear, wing fold areas, and other easy to reach areas are not usually neglected. However, squirt-can type lubrication of hinges, latches and sliding surfaces, and some out of the way flush type pressure lubrication points are frequently neglected to the point that serious corrosion and structural failures are being experienced.

Certain piano-wire type hinges, such as those found on access doors, are actuated only when periodic inspections are performed. On inspections, following cleaning and in between the inspection periods these hinges should receive an application of a water displacing preservative followed by a generous application of preservative type lubricating oil. The hinge should be actuated several times to insure that the lubricant has thoroughly penetrated all crevices.

When lubricating pressure fittings, make sure that all contaminated grease is forced out and replaced with new lubricant. Excess grease should be wiped from the fitting to prevent dirt accumulation.

Preservatives, sealants, covers, and screws are replaced as applicable and masking materials and protective covers removed. Areas protected by the masking and covers should be spot cleaned.

INSPECTION AND EVALUATION

Inspection for corrosion is a continuing task and should be handled on day-to-day basis. Overemphasizing a particular corrosion problem when it is discovered and then forgetting about corrosion until the next crises are unsafe, costly, and troublesome practices.

Most Periodic Maintenance Requirements Manuals and Maintenance Requirements Cards are complete enough to cover all parts of the aircraft or engine, and no part of the aircraft should go unchecked. Through experience it will be learned that most aircraft have trouble areas where corrosion will set in despite routine inspection and maintenance requirements. These trouble areas may be peculiar to particular aircraft models, but most aircraft operating in a marine environment are found to display similar conditions.

When corrosion is apparent, the extent of the damage must be determined. Evaluation of the damage may be classified as superficial or negligible damage, significant damage, repairable damage, or damage requiring replacement of the component.

When the extent of the damage has been determined, appropriate action must be taken. Negligible damage exists when the protective coatings are scarred or etched by corrosion damage. The corroded surface must be cleaned, treated, and refinished as applicable. Significant damage exists when the damage is within limits of applicable corrosion damage charts and the use of the affected parts may be continued after proper treatment. Repairable damage exists when damage exceeds the limits of applicable corrosion damage charts and use of the affected parts may be continued after authorized repair. Whenever repair limits are exceeded, the component must be replaced.

Nature and Appearance of Corrosion Products

The ability of maintenance personnel to recognize corrosion products occasionally presents a very real problem. The Aircraft Cleaning and Corrosion Control Manual, NavAir 01-1A-509, provides descriptive illustrations for the various types of corrosion products. The characteristics of corrosion products for aircraft materials are provided in table 4-1. The ability to recognize these products will require actual experience.

An adequate description of the nature of corrosion attack on the various aircraft metals has been previously covered in the Rate Training Manual, AME 3 & 2, NavTra 10309-C.

There are four requirements for corrosion to take place and all four are required in order for corrosion to occur. There must be an anode, a cathode, a metallic path for conduction of electrons, and a solution capable of conducting an electric current. Removing any one of these will prevent the occurrence of corrosion.

Detecting Methods

Corrosion detection is an integral part of the effort required to prevent corrosion action from spreading. In general, corrosion action begins on the surface of the metal and works to the core. Appearance of the surface or visual detection is therefore the most prominent indication of corrosion. Visual inspection should encompass the following areas:

Inspection of external finishes for scratches, cracks, tears, punctures, peeling, fading, blistering, or other visible damage, particularly around fasteners and in corrosion-prone areas.

Inspect exposed skin edges for condition of protective finish or sealant and for evidence of corrosion.

Inspect interior and exterior areas of known dissimilar metal contact for evidence of corrosion.

Inspect hidden surface areas whenever removal of equipment exposes these areas.

Areas around screws, bolts, and other fasteners should be inspected for corrosion and condition of primers and other protective coatings.

Inspect interior primed surfaces for scratches or other surface wear, with specific attention to interior corrosion-prone areas, including cables.

The nondestructive metal inspection techniques discussed in AME 3 & 2, chapter 4, are suitable for detection of stress corrosion cracks and intergranular corrosion depth. The more sophisticated methods such as X-ray and ultrasonics require the use of specially trained operators with experience in interpreting readout presentations.

Water leakage, which could promote corrosion, most often occurs around windows, doors, and access panels. Leaks also occur due to the constant working of airframe surfaces, at points where skins are joined, or where lines and fittings pass through bulkheads. Positive control of water entry requires a continuous schedule of drain maintenance and application of effective methods of sealing potential leak areas. Detection and immediate repair of leaks will materi-

Table 4-1.—Corrosion of metals—nature and appearance of corrosion products.

Table 4-1.—Corrosion of metals—nature and appearance of corrosion products.

Alloy	Type of attack to which alloy is susceptible	Appearance of corrosion product
Aluminum alloy.	Surface pitting, intergranular and exfoliation.	White or gray powder.
Titanium alloy.	Highly corrosion resistant.	Surface cracks.
Magnesium alloy.	Highly susceptible to pitting.	White powdery snowlike mounds and white spots on surface.
Iron-base non-stainless steel (4000-8000 series).	Surface oxidation and pitting, surface and intergranular.	Reddish-brown oxide (rust).
Iron-base stainless steel (300-400 series).	Intergranular corrosion (due to improper heat treatment). Some tendency to pitting in marine environment (300 series more corrosion resistant than 400 series).	Corrosion apparent by rough surface, sometimes apparent by red, brown, or black stain.
Nickel-base alloy (Inconel).	Generally has good corrosion resistant qualities. Sometimes susceptible to pitting.	Green powdery deposit.
Copper base alloy, brass, bronze.	Surface and intergranular corrosion.	Blue or blue-green powder deposit.
Cadmium (used as a protective plating for steel).	Good corrosion resistance. If attack occurs, will protect steel from attack.	White, powdery corrosion products.
Chromium (used as a wear resistant plating for steels).	Subject to pitting attack in chloride environment.	Chromium being cathodic to steel does not corrode itself, but promotes rusting of steel where pits occur in the coating.

ally reduce maintenance requirements at ~~a later~~ date.

Detecting points of water entry may be difficult, especially if water enters at one point and runs along seams, following a diverse course. The use of low pressure compressed air and a water and detergent solution is effective in pinpointing leakage points. The detergent solution is applied to the exterior surface and air is applied internally. Any leak should produce sufficient bubbles to be detected. If fresh water is not readily available, a similar procedure of using the compressed air and listening for the hissing sound of the escaping air may be used.

Use of a listening device such as a stethoscope or plain hose will eliminate background noise and assist in isolating the point of escaping air. Spraying with fresh water and observing the suspected leak area can also be used, but this method tends to interrupt other maintenance on the aircraft. Whenever the leak is detected, the area must be thoroughly cleaned and dry before resealing.

INSPECTING FOR MICROBIOLOGICAL CORROSION.–Inspection for microbiological corrosion consists of draining samples from the suspected tanks into sterile containers for laboratory analysis. With the aircraft defueled, remove and inspect fuel system filters for abnormal discoloration, rust particles, slime, or fungus deposits. With the tanks still wet, the interior is inspected through access openings, using a vapor-proof flashlight and mirror. After the residual fuel has evaporated, and the tanks are dry, inspect for pinholes, bare areas, blisters, or discoloration. Internal inspection should include all components that are normally immersed in fuel.

The residues of biological contamination are usually green to brown in color and have a slimy texture when wet. If doubt exists as to whether residues are of a biological origin or the usual fuel tank sediment, submit specimens to a laboratory for examination. Removal of these residues may reveal surface or pitting corrosion. If slime or fungus has grown in the tank, minor corrosion damage may also be present on metal surfaces of operational components in the tank.

INSPECTING FOR METALITE (HONEYCOMB) CORROSION.–Metalite exterior surfaces are made up of aluminum separated by a thin metal honeycomb and are highly susceptible to corrosion. A surface bulge may indicate corrosion between the core and the surface. Bulges can be detected by viewing the surface from a low angle or by tapping the surface with a coin or key and listening for the distinctive sound change which would indicate core separation or corrosion damage. Water collection or penetration through defective edge sealants is the most common cause of corrosion in Metalite. Proper inspection and maintenance will be necessary to provide adequate protection.

Corrosion-Prone Areas/ Repair Guides

Certain corrosion-prone areas such as exhaust trail areas, engine frontal areas, piano hinges, JATO, rocket, and gun blast areas, battery compartments, lavatories and galleys, bilge areas, wheel well, landing gear, wing fold, flap, and speed brake recesses are considered common to all aircraft and have been previously discussed in the AME 3 & 2 Rate Training Manual.

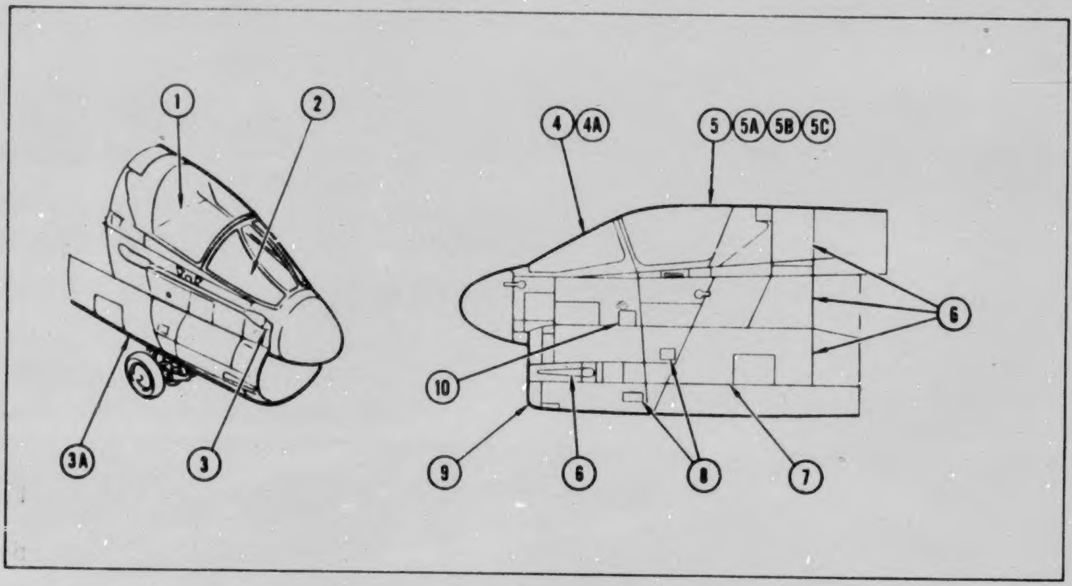
The Aircraft Cleaning and Corrosion Control Manual, NavAir 01-1A-509, provides descriptions and illustrations of the interior and exterior corrosion-prone areas on most naval aircraft. These areas are covered in greater detail in the specific Aircraft Maintenance Instruction Manuals, Maintenance Requirements Cards, and some Structural Repair Manuals.

It is essential to establish the exact location of magnesium and ultrahigh strength steel parts, engine, rocket, and missile exhaust impingement areas, piano hinges, and control cables. Experience has shown that these areas require more attention than other corrosion-prone areas.

The demand for more emphasis on corrosion is slowly resulting in more specific corrosion maintenance instructions. Figure 4-12 illustrates one manufacturer's attempt to provide that increased emphasis by detailed corrosion-prone area and repair guide sheets for all areas of the aircraft. These sheets pinpoint the area, the type of corrosion attack normally encountered in each area, the probable cause, and the recommended repair action.

MISCELLANEOUS TROUBLE AREAS.–A variety of additional trouble spots exists; some covered by scattered technical directives, others known only from long experience. Most Aviation Structural Mechanics may be able to add a favorite to the following:

Any hose assembly in which internal wire braid is present, located in positions subject to frequent water soakage, requires some type of protective treatment whenever such assemblies are replaced in the aircraft. The current applicable instruction is Accessories Bulletin No. 16-61. Any maintenance program should include inspection of installed hose assemblies for compliance with the applicable bulletin and correction of those assemblies not previously treated.



Index No.	Corrosion-Prone Areas	Type of Corrosion	Probable Cause	Recommended Repair (Refer to repair sections for damage limits, this manual and NAVAIR 01-45AAA-3-2.)
1	Ejection Seat Guide Tracks	Pitting	Worn surfaces and/or scratches	Clean and remove corrosion in accordance with NAVWEPS 01-1A-509. Lubricate tracks with MIL-M-7866 lubricant.
2	Pilot's Floor Assembly	Galvanic and Pitting	Dissimilar metals, trapped water and debris	Clean and strip finish in accordance with NAVWEPS 01-1A-509. Remove corrosion in accordance with NAVWEPS 01-1A-509. Refinish surface as follows: a. Condition surface in accordance with paragraph 1-390, this section. b. Surface treat in accordance with paragraph 1-394. c. Apply MIL-P-23377 epoxy-polyamide primer in accordance with table 1-16 and paragraph 1-422. d. Apply MIL-C-22750 epoxy-polyamide enamel in accordance with table 1-17 and paragraph 1-423.
3	Inflight Refueling Probe Cavity Inflight Refueling Probe Adapter	Galvanic and Pitting	Dissimilar metals, trapped debris, worn surfaces, mechanical damage to surface or finish, and plugged drain holes	Clean and remove corrosion in accordance with NAVWEPS 01-1A-509. Perform repairs as follows: a. Classify damage in accordance with paragraph 1-31, this section.

AM.911

Figure 4-10.—Corrosion-prone areas and repair guide (example).

Trimmed edges of sandwich panels and drilled holes should have some type of corrosion protection. A brushed inhibitor solution treatment or an edge application of sealant, or both, is recommended. All gaps and cavities where potentially injurious materials may be trapped should be filled with sealant. Temporary sealing should be effected immediately if a delay in permanent repair is anticipated.

All cables, whether plain carbon steel or corrosion-resistant steel, should be inspected for condition at each periodic inspection. Cables should be inspected by random cleaning of short sections with drycleaning solvent-soaked cloths to remove oil and preservative compounds. Pay particular attention to sections passing through bulkheads, fairleads, and around pulleys and grooved bellcrank arms. Should external corrosion be evident, tension should be relieved and the cable checked for corrosion of internal strands. Light external corrosion may be removed with a soft steel wire plater's brush. When corrosion products have been removed, the cable must be recoated with corrosion preventive compound (MIL-C-16173). Grade 4 is used for interior cables and grade 1 for exterior cables. Do not apply preventive compounds so thick as to interfere with the motion of cables through fair leads, sheaves, or bellcrank arms.

Cables with moderate to heavy corrosion on external surfaces, cables with corrosion on internal strands, and cables which have broken strands caused by corrosion must be removed and replaced.

In general, the applicable Maintenance Requirements Cards provide a ready means to insure adequate inspection of all compartments and interior aircraft cavities. When such general requirements are observed along with a periodic check of the common trouble areas, adequate maintenance should be assured for most operating conditions. Frequent reference to the requirements expressed in the Aircraft Cleaning and Corrosion Control Manual, NavAir 01-1A-509, is recommended to insure complete and current coverage.

The most effective means of preventing the onset of corrosion is the maintenance of the condition of surface finishes. This may be accomplished by the judicious use of paints, primers, sealants, or preservatives as appropriate. The important thing is that something be done at the earliest practicable moment in order to minimize the continuation and spread of deterioration until more extensive preservation can be accomplished.

AIRCRAFT PRESERVATION

The requirements for preservation of both idle and operating aircraft are detailed in NavAir 15-01-500, Preservation of Naval Aircraft. These requirements are designed to prevent the deterioration of aircraft and components from any cause.

The susceptibility of an aircraft to corrosion damage is greatest during those periods when the aircraft is inactive or being shipped. Consequently, definite rules for the protection of idle aircraft have been developed which have proven to be capable of preventing deterioration under most storage conditions. They are as follows:

Type A preservation is applied to aircraft awaiting overhaul, conversion, modernization, and strike, and those which have completed their service life. It is also designated for use on aircraft which are in an indefinite storage status or when it is known that the aircraft will be inactive for longer than 6 months. Although type A storage is classified as indefinite storage, effective life is affected by the variations in storage conditions. In most cases outdoor ventilated type storage will be used, and under these conditions representation will be necessary after 3 years. The limitation is imposed primarily by the effective life of barrier materials, sealing tapes, and preservative coatings. If storage is under indoor dehumidified conditions, the storage is considered indefinite and no represervation at intervals is required.

Type B preservation is generally applied to serviceable and modernized aircraft that are essentially in a flight ready condition at the time of preservation. Aircraft in this category can be stored and maintained in type B preservation for a maximum of 6 months. Type B preservation is ordinarily utilized by Naval Air Rework Facilities or other Depot level maintenance facilities. At the end of each 6-month period, aircraft scheduled to return to service without overhaul, rework, or modification are completely depreserved, ground tested, repaired as necessary, and test flown. If they are scheduled for overhaul, rework, or immediate modification, the test flight may be eliminated.

Type C preservation is used for aircraft to be shipped by ocean surface vessels, trucks, or railroad cars where maintenance facilities and personnel are not available for en route maintenance under type D requirements. Type D may be used in place of type C when specifically authorized. Shipment on low freeboard vessels such as tankers and barges, and cross country open rail and truck shipment where dust, rain, or windstorms are likely to be encountered, and ocean shipment when trained maintenance crews are not assigned to accompany and maintain the aircraft requires the use of a complete strippable plastic coating system.

Type D preservation is applied to any operating aircraft that is not flown at least once each 14 days. Type D preservation offers basic protection, with all other procedures being modifications to fit longer or special storage conditions. Aircraft may be maintained in type D preservation for an indefinite period if all discrepancies are corrected promptly and preservation is renewed at the end of each 30-day period. Renewal consists of completely depreserving, ground testing, repair as necessary, and test flight, prior to represervation.

Type E preservation (salt water or chemical damage) is performed on aircraft that have crashed in salt or fresh water or have been subjected to fire extinguishing chemicals or foams. For the preservation to be effective, it should be applied as soon as possible after the accident. Essentially, type E preservation consists of removing all traces of corrosive water, salt deposits, or firefighting chemicals, and preserving the cleaned, dried components. It is considered temporary or emergency treatment and prompt overhaul is necessary to complete the salvage operation and prevent additional damage.

Maintenance of preservative coatings on operating aircraft presents different problems than those involved with idle aircraft. Coatings and finishes are subject to wear, erosion, abrasion, and contamination. Conditions and requirements will vary considerably with land-based aircraft, depending on geographical location and operational commitments.

Under operating conditions, it is frequently necessary to supplement the protection already present on aircraft surfaces, or to provide temporary protection to damaged areas, by the use of various preservative coatings. While any coating of grease or oil is better than leaving a critical metal surface bare, the protection offered by such material is poor when compared to materials strictly compounded for preservation purposes.

For example, a coating of operating hydraulic fluid (MIL-H-5606) will protect a steel panel immersed in water for approximately 48 hours. The same metal panel coated with inhibited hydraulic fluid (MIL-H-6083), which is also red and looks identical to the operating oil, will show 100-percent protection for a period of 30 days or more. The additional protection results from the presence of small amounts of special additives, which form very thin monomolecular films on metal surfaces, that in turn tends to exclude corrosive moisture and oxygen. These inhibiting materials may be added to solid film materials or to oils of various weights and compositions.

Another inhibited preservative which may be used is lightweight lubricating oil, Federal Specification VV-L-800. This material is effective as a short-time protective coating on metal surfaces. It is presently used to lubricate piano hinges on exterior surfaces of aircraft.

It is not intended that preservative coatings should be used as a substitute for good maintenance practices. The "coverup with preservative method" of corrosion treatment is strictly forbidden under current instructions. The only time it is permissible to cover active corrosion with preservative coatings is during actual operations as a temporary measure when the corrosion damage is not extensive enough to cause a detrimental safety-of-flight condition. Complete corrective treatment should be scheduled at the earliest practicable moment consistent with flight operations. Serious corrosive attacks require immediate corrective action. These attacks will usually be evidenced by a buildup of corrosion products which will bubble through preservative coatings. If there is evidence of such a corrosive attack, the affected areas should be thoroughly cleaned of all preservatives, followed by corrosion treatment, protective finish replacement or touchup, and reapplication of the preservative coating.

A brief description of some of the more common preservatives which are readily available in Navy stock is included for information.

Specification MIL-C-16173 covers three different grades of preservative materials that can be thinned or diluted with drycleaning solvent as necessary, and can be applied by brushing, spraying, or dipping in cold solution.

Grade 1 preservative material forms a hard, dry film for long term protection of metallic surfaces and control cables in accessible areas.

Grade 2 preservative is a soft film, grease type material that can be used on most operating parts, and is readily removed by any petroleum solvent. Its chief disadvantage is the fact that it may be washed off under direct exposure to salt water or may be removed by inadvertent wiping. It does protect under relatively severe conditions and, given adequate maintenance and touchup as necessary, can be used for most maximum protection requirements.

Grade 4 preservative forms thin, semitransparent films through which identification data can usually be read. It also sets up relatively dry to the touch so that preserved parts may be easily handled. This grade is used for protection of control cables in inaccessible or protected areas. It has proved to be particularly effective in protecting wheel well areas and other exposed surfaces where film transparency is required and moderate protective characteristics can be tolerated. The main disadvantages of this material is that it is easily removed by water spray and requires replacement at 1-month intervals under severe exposure conditions.

Corrosion preventive compound MIL-C-81309 is a water displacing agent which can be used to displace entrapped moisture. Following application of MIL-C-81309, the area should be protected with Grade 4 preservative.

Sprayable, Strippable Coating Compounds

Activities based outside of the continental United States occasionally receive aircraft from rework activities or the procuring agency via ocean surface shipment. This is especially true of helicopter and limited range fighter aircraft. These aircraft are protected during shipment with a sprayable, strippable coating system, conforming to MIL-C-6799, Type II. Type II coating systems, which are more common to maintenance personnel, are normally applied by spraying and have no harmful effects on metal, plastic, or painted surfaces. It is also useful for protecting transparent acrylic surfaces, such as canopies, against abrasion during maintenance or extended periods of down time. The type II system consists of a black or black/gray combination base coat and a white topcoat to provide maximum heat reflection during outside exposure. When using the black/gray combination base coating, the black material is intended as the base or first coat. The gray is intended as an intermediate contrasting coat to be applied over the black base coat. Nylon ripcords with finger size loops are placed strategically about the aircraft prior to spraying to accommodate the manual stripping of coatings. When properly applied, the coatings can be easily removed. If coatings are sprayed too thin for easy removal, they can be recoated and allowed to dry. The top layer will adhere to previous layers and all layers may be manually stripped in one operation.

PROTECTION DURING MAINTENANCE AND REPAIR

During any period of inactivity or partial disassembly, it becomes doubly important to observe minimum maintenance requirements. All too often these are neglected because primary emphasis is directed toward the completion of the repairs.

It is just as important to protect and maintain preservation on aircraft during maintenance and repair periods as it is to protect the aircraft after it is returned to "upstatus". Every precaution should be taken to protect critical surfaces during all stages of maintenance and repair, especially if the work is being accomplished out of doors.

Exposed shafts, splines, and gears should be protected with preservative coatings or general-purpose grease films during all waiting periods. All openings should be kept sealed off until installations are complete. All components that are grease lubricated in service should be lubricated prior to, or immediately following, installation. All protective coatings damaged during maintenance and repair should be restored; e.g., touch up control cables as necessary. Exposed critical steel parts should be protected with coatings of soft film preservative or general-purpose grease, particularly during outside storage periods. Keep open lines capped off at all times. Take every precaution to avoid marring or destroying chemical finishes on magnesium and aluminum parts. Touch up any scratches on such parts with zinc chromate primer and restore the original finish whenever practicable. Maintain preservative coatings at all times during the work.

CORROSION REMOVAL AND TREATMENT OF AFFECTED AREAS

Complete removal of all corrosion products and damaged metal is of vital importance. Residues and corrosion products which have not been removed can continue to corrode after protective coatings have been reapplied. Corrosion which has been covered in this manner may progress to a critical stage in the strength of the part before it is again detectable by surface inspection. The bottoms of pits and lines of corrosion are frequently very sharp and constitute stress risers, or concentration points. In areas subjected to repeated loading, these discontinuities multiply the effective load around the bottom of the pit or line of corrosion and can cause premature cracking and failure. With this in mind, corrosion removal and treatment of the affected areas become as important as its detection.

PAINT AND DECAL REMOVAL

Paint films are removed by the application of paint thinner whenever possible. Residual paint films may be stripped completely or mechanically abraded to remove loose flaky paint as necessary. Abrasive webbing nylon mat is available in 9-inch by 6-inch sheets in very fine, fine, and medium grits for removing superficial corrosion products and paint scuffing prior to touch-up. In all cases the use of abrasive materials such as abrasive sheet material, abrasive impregnated nylon wheels, abrasive webbing nylon mat, glass vacu-blast beads, etc., should conform to those types of materials listed in NavAir 01-1A-509. Use of the proper abrasive materials will minimize the possibility of introducing dissimilar metals which could amplify the possibility of corrosion. Scrapers used in paint removal should be made of nonmetallic material. Improper utilization of equipment can result in the removal of good base metal. The use of carborundum (silicon carbide) sanding paper as a substitute for aluminum oxide paper is prohibited.

The use of paint strippers is preferred only when it is necessary to strip all paint to the bare metal for the purpose of more accurate evaluation of corrosion damage and refinishing procedures. Only the corroded areas should be stripped completely. When restoring deteriorated topcoats, it is recommended that lacquer topcoats be stripped with a suitable solvent such as methyl ethyl ketone rather than strip the complete paint system.

The type of paint finish may be identified by a decal or stencil located on the right side of the aircraft either above or below the horizontal stabilizer.

Materials

Paint removers are toxic and contain ingredients that are harmful to the skin and eyes. It is mandatory that a face shield, rubber gloves, and a chemical repellent apron be worn while using paint strippers. If remover gets on the skin, immediately flood the affected area with large quantities of water. Rinse freely with diluted alcohol and apply glycerin or petrolatum. If remover gets into the eyes, flood the eyes with water, bathe the eyes with a 3 percent boric acid solution, and add a few drops of U.S.P. castor oil. This should always be followed by obtaining medical aid immediately.

Epoxy remover, MIL-R-81294, is effective in removing acrylic and epoxy finishes. Like most removers, it will adversely affect fabrics, fiberglass, acrylic windows, plastic surfaces, and rubber products. The use of solvent-resistant tape and masking materials is required to prevent possible contact with these materials.

Nonphenolic paint and lacquer solvent type remover, conforming to specification TT-R-248, is recommended for use on enamel, acrylic nitrocellulose, and cellulose nitrate paint systems.

Fluorescent paint remover, MIL-R-21972, is an alkali-organic solvent type remover recommended for use in removing camouflage, fluorescent, and wax coatings from aircraft.

Paint remover, conforming to MIL-R-18553, is used where contact with synthetic rubber is unavoidable.

Paint strippers must not be used on structural fittings such as wing spars, landing gear, etc., due to the possibility that such acid type removers may cause hydrogen embrittlement and subsequent part failure.

Stripping Procedures

Paint removers are in liquid form, semi-viscous, nonflammable, and water rinsable. They may be used as received and are applied by dabbing with a brush. Removers are subject to aging and therefore should not be stored in large quantities in excess of immediate needs.

General use of removers includes the masking of all areas where contact with the remover is not desired. Care must be taken around sealant seams, since the stripper will tend to soften and deteriorate the sealant and allow the ingress of water, electrolyte, and other corrosive contamination. Apply the stripper to the area being refinished, using a dabbing action. Brushing tends to decrease the softening ability of the stripper. Allow the stripper to remain in place until the paint film is softened or lifted as indicated by its wrinkled appearance. Scrub the surface with a brush or scraper to loosen any paint as necessary. Additional saturation with remover may be required where the paint remains tight or where the stripping material has dried.

The residual stripper and loosened paint are removed by washing and scrubbing the surface with a low to medium pressure spray of water. The area is then cleaned with approved cleaners and the masking materials removed. The use of nonmetallic scrapers or abrasive webbing pads is approved for removing persistent paint finishes.

Generally, decals will be affected by the action of the previously mentioned strippers and solvents; however, other methods may be required for their complete removal. Decals can be loosened by the application of heat, using radiant heat lamps or a hot air gun. The edge of the decal is lifted, using a beveled micarta or Plexiglas scraper and then manually pulling the decal off. Any adhesive remaining on the surface can be dissolved and removed with a solution of 75 percent toluene and 25 percent isopropyl alcohol, methyl ethyl ketone, or methyl isobutyl ketone. Use of heating devices in fuel cell areas is prohibited. Alternate methods of removing decals in these areas include the use of suitable strippers such as Pennsalts E-Z Strip 19A or equivalent. Several coatings are applied to the decal and allowed to set for 20 to 30 minutes. The decal will loosen enough to be manually stripped from the surface. Remaining adhesive can be removed in the same manner as for other removal methods.

CORROSION PRODUCT REMOVAL

After the paint has been removed from corroded areas, it is necessary to remove all corrosion products before an accurate evaluation of the extent of damage can be made. The corrosion removal procedures for the various aircraft metals are discussed in the following paragraphs. Corrosion removal procedures are covered in detail in the Aircraft Cleaning and Corrosion Control Manual, NavAir 01-1A-509. In the event of conflict between the corrosion control volume of the Maintenance Instructions Manual for a specific aircraft and NavAir 01-1A-509, the latter will take precedence.

Corrosion products are always removed by the mildest method available. Mechanical methods have proven best suited in minimizing the removal of sound metal and avoiding surface damage. High-speed grinders and sanders are prohibited because they can damage parts by removing sound metal and concentrating heat and stress.

Mild to medium corrosion is removed by vacu-blasting with abrasive glass beads. This method has proven most effective in removing corrosive residues on irregular surfaces and pitted areas. A discussion of the Vacu-Blast Dry Honer is provided in AME 3 & 2. Additional coverage is provided later in this chapter.

Small areas of mild to medium surface corrosion is removed with aluminum oxide abrasive paper, 300-400 grit, or aluminum oxide nylon webbing.

In areas where corrosion is severe, removal is accomplished using an air-driven drill motor and an aluminum oxide abrasive bonded nylon wheel if skin thickness is greater than 1/16" thick.

Removing Exfoliation Type Corrosion

Exfoliation type corrosion is the result of intergranular attack in which separation and lifting of metal layers occur. It is the hardest type to detect in its early stages. It is usually first evident as small raised areas or bumps under the paint film. As attack progresses, corrosion products break the paint film, and separated layers of metal become visible. Removal of all visible exfoliated metal frequently exceeds the allowable corrosion damage limits. Critical areas should be evaluated by competent authority to prevent flight hazards.

Removal of exfoliated metal is accomplished using abrasive impregnated nylon wheels. Vacu-blasting is not considered satisfactory but is permissible for final cleanup of the corroded area. When all the products of corrosion are removed, exposed edges should be blended and polished to accommodate refinishing procedures.

Depressions resulting from corrosion removal are cleaned, chemically treated, rinsed, and air dried. The depression is then filled with MIL-S-8802 sealant and faired with the surrounding surface. The scraper used to smooth the sealant will be easier to use if it is dipped in water prior to making the final fairing strokes.

Corrosion Removal Around Fasteners

Corrosion removal around fasteners is difficult without removing the fasteners. However, permanent fasteners must not be removed, unless specific approval is granted. Corrosion is removed by vacu-blasting, or other mechanical means, with care being taken to minimize the removal of cadmium plating from the fasteners. If replacements are available, corroded removable type fasteners should be replaced.

Anodized Surfaces

The oxide film provided by anodizing aluminum offers natural protection against corrosive attack. When this film is damaged in service, it can only be partially restored by chemical surface treatment.

Abrasive impregnated nylon webbing is adequate for corrosion removal. Additional care should be exercised to avoid unnecessary removal of protection. Following corrosion removal, the anodized surface must be cleaned, chemically treated, rinsed thoroughly, and allowed to dry before reapplying a complete touchup paint system. Touchup painting is covered later in this chapter.

Unpainted (Clad) Aluminum Surfaces

Unpainted aluminum sheets with pure aluminum (clad) coatings offer greater resistance to corrosion than unclad or bare aluminum alloys. Due to the harsh environment that most naval aircraft are subjected to, unpainted clad surfaces are becoming rare. Care must be exercised to prevent staining and marring, and minimize removal of the protective layer. Oil and surface dirt are removed with water emulsion cleaner, and corroded areas are hand polished with metal polish conforming to MIL-P-6888. This polish removes stains and light surface corrosion and provides a high, lasting polished finish. It is not recommended for use on anodized surfaces. Polished clad may be coated with waterproof, solvent type aircraft wax to provide additional protection.

Corrosion Removal from Magnesium

Some magnesium parts in current aircraft have been originally protected by a proprietary electrolytic process. The DOW 17 electrolytic coating has a green to grayish green color. The HAE process is identifiable by its brown to mottled gray appearance. Electrolytic type coatings provide thicker protective coatings than brush or dip type coatings. These finishes cannot be restored in the field and care should be taken to minimize their removal.

Corroded areas are cleaned and stripped, and corrosion removed by using abrasive impregnated nylon webbing and vacu-blasting with abrasive glass beads. The paint edges around the corroded area are feathered and the area recleaned with water emulsion cleaner. The area is then rinsed thoroughly with fresh water. With the surface still wet, chemical surface treatment, MIL-C-5541, is brushed on until the metal is a uniform light brown color. This surface treatment is the same as that used for pretreating aluminum. The solution is mixed in the same manner as recommended for aluminum; however, the reaction will be much faster on magnesium. The treatment solution is rinsed off thoroughly, using fresh water, and the surface allowed to air dry. Depressions are filled with sealant and appropriate finishes of epoxy primer and acrylic lacquer topcoat applied.

Corrosion Removal From High Strength Steel

The only approved method of removing corrosion from high-strength steel parts is by vacu-blasting with glass beads, or hand methods using a fine grit abrasive impregnated nylon webbing or 300- 400-grit aluminum oxide paper. Power-driven tools are emphatically prohibited.

Stainless Steels

Stainless steels have corrosion resistance due to oxide films formed by passivation at the time of manufacture. Exposure to abrasion and atmospheric conditions cause these films to break down over prolonged periods. Corrosion treatment is limited to cleaning with P-D-680, solvent drycleaner, followed by hand corrosion removal with abrasive impregnated nylon webbing and cleaning with water emulsion cleaning solution.

Titanium Alloys

Titanium is highly corrosion resistant, but it may show deterioration from the presence of salt deposits and other contaminants, particularly at elevated temperatures.

When titanium surfaces require cleaning and corrosion treatment, the same procedure used for stainless steel is utilized.

Copper Alloys

Corrosion attack on copper alloys is usually limited to superficial staining and tarnish. Neither are considered damaging and should ordinarily have no effect on the function of the part. Stains and tarnish can be removed by using a 10 percent solution of citric acid as a brightener bath. The part can be immersed in the solution or treated in place by brush application of the solution. Care must be taken to prevent solution entrapment. Following application, the part should be thoroughly rinsed with fresh water to remove all residual solution.

Metal Coatings

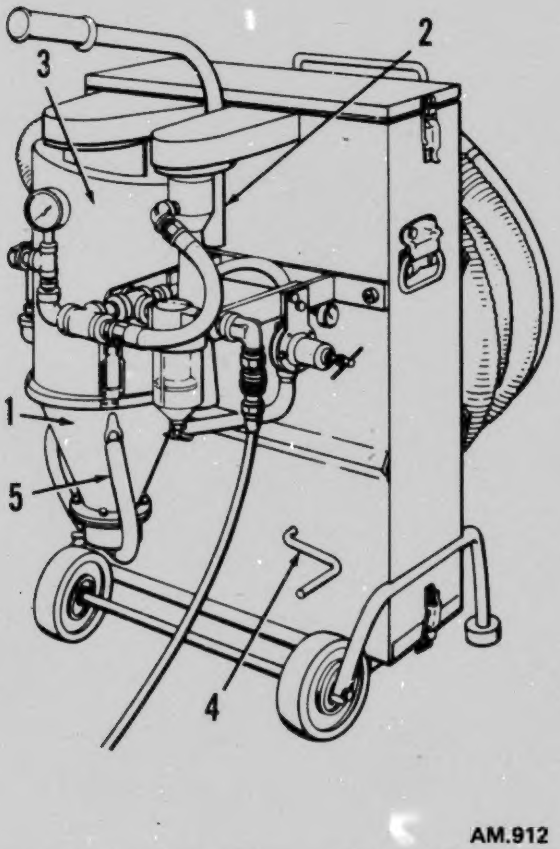
Silver, gold, platinum, nickel, and chromium are used in aircraft because of their electrical characteristics or wear-resistant qualities. Chromium and nickel wear-resistant coatings (plating) protect underlying metal by forming a physical barrier. Breaks in the coating destroy protection. Tarnish or discoloration can be removed with MIL-P-6888, aluminum polish. When plating on a part fails, the underlying metal should be mechanically cleaned and temporary protective coatings applied until the part can be repaired or replaced.

MECHANICAL CORROSION REMOVAL BY BLASTING

One approach to more complete removal of corrosion products on assembled aircraft is the use of portable vacu-blast equipment. Specialized training and licensing for the use of power tools and the vacu-blast machine is required for at least four rated structural mechanics in each operating squadron.

The Vacu-Blast Aero Dry Honer is a portable self-contained lightweight unit utilizing the dry vacuum return system. It is the only authorized blasting method of removing corrosion on assembled aircraft. With this machine the work is more visible and metal removal can be held to closer limits. The machine is air operated and can be used in shore-based or shipboard operations.

Figure 4-11 illustrates one type of portable dry honing machine used to remove corrosion products from metal.



1. Abrasive storage tank.
2. Air ejector pump.
3. Abrasive reclaimer.
4. Filter bag shaking handle.
5. Suction bypass line.

Figure 4-11.—Portable vacu-blast dry honing machine.

Since the Vacu-Blast Aero Dry Honer is described and illustrated in detail in AME 3 & 2, NavTra 10309-C, chapter 4, no further information on this subject is presented here.

CORROSION DAMAGE LIMITS

Corrosion, however slight, is damage and must be treated as such. The amount of metal removed detracts from the overall margin of safety built into the aircraft by the manufacturer. The amount of base metal removed must be measured and compared with allowable limits established by the manufacturer and published in corrosion control volumes of specific Maintenance Instructions Manual and Structural Repair Manuals. Limits for major, primary, and secondary structures are generally found in the Structural Repair Manual. Limits for certain components are published in the corrosion volume of the Maintenance Instructions Manual. Complete evaluation and classification of the damage as superficial or negligible, significant, repairable, or damage requiring replacement will require mature judgment based on information provided in both manuals. Requests for evaluation by engineering personnel or higher authority may be necessary.

Where corrosion damage limits have not been published, use 80 percent of the mechanical damage limits in applicable aircraft publications and report this lack of information on an Unsatisfactory Material/Condition Report, UR.

CHEMICAL SURFACE TREATMENT

Chemical conversion coatings are used to increase corrosion resistance and improve adhesion of subsequent coatings. After cleaning and removal of surface oxides, aluminum and magnesium surfaces should be treated with MIL-C-5541 chemical film. This conversion coating is easily damaged during aircraft maintenance or contaminated by grease, oil, and other foreign matter. Once the area is treated, it should be painted as soon as practicable after the surface has air dried.

The soluble salt residues remaining on the surface after use of MIL-C-5541 will accelerate corrosion and can cause blistering of paint finishes if it is not rinsed thoroughly. Rinse with fresh water and allow the surface to air dry. Wiping to dry the surface is prohibited, as the chemical film is easily damaged by the abrasive action of wiping prior to initial drying. Air drying will usually take 1 hour, dependent on temperature and humidity.

The complete procedure for using MIL-C-5541 consists of insuring that the surface is clean, followed by brush applications of the chemical solution. Repeated application of fresh solution will produce a uniform coating with an iridescent yellow to brown color. The area is then rinsed and allowed to air dry. A powdery film coating indicates poor rinsing or failure to keep the surface wet during the treatment. Should this occur, retreatment is necessary.

As previously stated, the reaction of MIL-C-5541 on magnesium will be much faster than when used on aluminum. Vacu-blasted areas may display slightly different reaction than non-blasted areas.

CAUTION: Personnel using MIL-C-5541 must wear protective eye goggles, chemical repellent aprons, and rubber gloves.

AIRCRAFT AND COMPONENT PAINTING AND TOUCHUP

At the Organizational and Intermediate levels of maintenance, touchup for all types of paint systems is identical. Use epoxy primer, MIL-P-23377, topcoated with acrylic lacquer, MIL-L-81352. This touchup system is compatible with all present paint systems.

The adequacy of aircraft and component paint coatings should be based on their corrosion-protection ability and not appearance. The practice of overspraying for eye-appeal is prohibited because of the potential for intercoat adhesion failures and the covering up of corrosion. Man-hours expended for unnecessary painting can be used more effectively for corrosion prevention, removal, and touchup of actual corroded areas

Senior AM personnel, including AME's, supervising corrosion maintenance should insure that only approved materials, equipment, and procedures are used when painting aircraft and components. Paint procedures, materials, and equipment are adequately covered in AME 3 & 2, NavTra 10309-C, and therefore not repeated here.

Aircraft Markings

Information, warning, and other miscellaneous markings on aircraft are either stencil form or decals. Occasionally they become damaged or obliterated to the point of not serving their intended purpose and require replacement. Many of the stencils and decals are readily available, via supply, from the aircraft manufacturer or the Naval Air Rework Facility designated as the overhaul point for the specific aircraft. Appropriate reference on the availability of these stencils or decals is provided in the specific Maintenance Instructions Manual or Illustrated Parts Breakdown.

Stencil and decal type markings are located and applied in accordance with Specification MIL-I-18464, Insignia and Markings for Naval Aircraft, and the appropriate Maintenance Instructions Manual.

Decal type markings are available in either pressure-sensitive or solvent-activated form. To apply pressure-sensitive decals, the area to which the decal is to be applied is cleaned with a cloth moistened with isopropyl alcohol and allowed to dry. Remove the backing from the decal and apply the decal to the surface. When applying large decals, wetting the surface to be decaled with a detergent solution will allow the decal to be aligned without adhering. Once it is aligned, squeegee the decal to remove water under the surface. Work out all air bubbles and wrinkles, using a dry lint free cloth and allow the decal to dry. Coat the outer surface of the decal with specified clear decal sealant so that the complete decal and edges are sealed to prevent lifting.

For solvent-activated decals, peel off the backing and apply a very light coat of specified activator with a cloth or felt pad. Insure that the complete surface is covered. Excessive activator will prevent the decal from adhering and ruin the decal. The decal is then applied to the surface in the same manner as prescribed for pressure-sensitive decals.

CORROSION CONTROL KIT AND MATERIALS

A corrosion control kit is available for operating activities and is especially useful for small detachments. The kit is primarily designed for use in treating small areas of corrosion and contains all the necessary materials and equipment. A compartmented case provides orderly storage of materials. Most materials are identical to materials discussed in AME 3 & 2, and this chapter.

A maskant material is provided to use in paint stripping operations. The maskant is squeezed around the area to be stripped and forms a dam to protect areas where paint remover is not desired. The maskant must be high enough to contain the paint remover. After the paint is lifted or softened, the loosened paint, paint remover, and maskant material are removed by using the micarta scraper, which is provided in the kit, to work the material toward the center of the encircled area. The residue is then scraped into a disposable plastic bag. A washing bottle is provided for rinsing the area following stripping and chemical treatment of the corroded area.

The epoxy polyamide primer packages are supplied in plastic squeezable bags. At least 1 hour prior to use, the two components are mixed by pressing the inner bag of component two, so that it breaks, and then kneading the outer bag until the two components are thoroughly mixed. When ready to use, the top of the bag is opened and the primer brushed on. Topcoat is available in aerosol spray cans.

All other materials are common to corrosion maintenance personnel. Complete instructions or appropriate reference to the Cleaning and Corrosion Control Manual is provided in each kit with the arrangement of materials supplied in the kit printed on the back of the instruction sheet. Materials in the kit may be replenished from standard stock as necessary to maintain the kit.

CHAPTER 5

OXYGEN SYSTEM SUPPORT EQUIPMENT

Oxygen systems of naval aircraft require several types of support equipment to insure their safe and satisfactory operation. AME's are concerned with support equipment that is used for storage, servicing, and testing of oxygen. In this chapter a vaporizing system, storage tanks, and servicing equipment as well as oxygen purity test equipment are discussed.

As senior AME's, it is your responsibility to see that all personnel of the AME rate know and understand the safety precautions that are involved when working with or handling liquid or gaseous oxygen and its equipment.

This information should not stop with just the personnel of your rate, but it should be stressed to all aviation maintenance personnel, so as to avoid their mishandling and treatment (playing with valves of service trailers, standing or sitting on trailers, hauling tools and equipment on them, spilling of oils and fluids on them etc.), of AME servicing equipment and the possibility of creating hazardous conditions that could cause serious injury to themselves or others.

Safety precautions applicable to this chapter are covered throughout the text. Organization and administration of safety programs is covered in Chapter 2.

VAPORIZING SYSTEM MODEL FY-1200

The high pressure liquid oxygen vaporizing system is a unit designed to receive liquid oxygen at approximately atmospheric pressure, compress it; vaporize it, and charge it as a gas into cylinders.

DESCRIPTION

This vaporizing system is manufactured as two basic units; one is a portable unit for field operation, and the other is a stationary unit for operation in a permanent building or facility.

The portable unit, illustrated in figure 5-1, is equipped with a motor plug to receive the external source of electric power and is completely contained on a skid. A schematic of the vaporizing system is illustrated in figure 5-2. Reference to this figure while reading the text will aid in understanding the system, component operation, and oxygen flow.

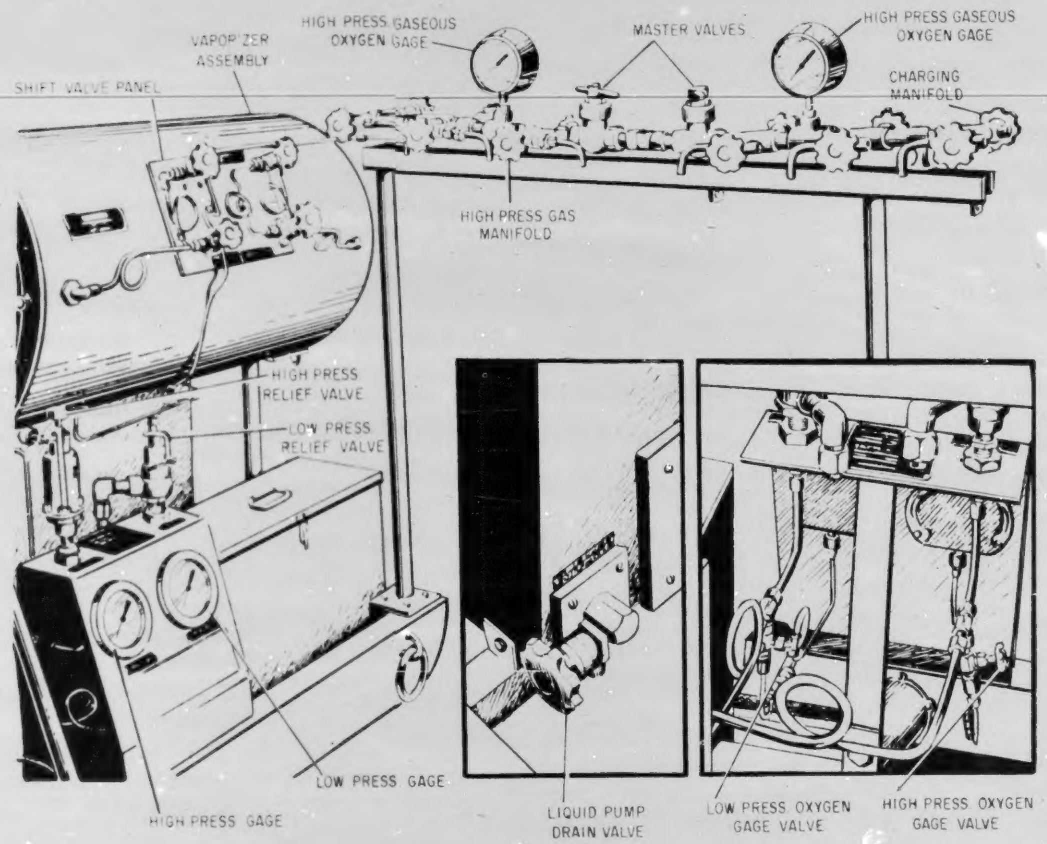
The stationary unit consists of three assemblies–the pump assembly, which requires a concrete foundation; the vaporizer assembly; and the charging manifold assembly along with the necessary controls and instruments for operation.

Liquid Oxygen Pump

Liquid oxygen enters the pump jacket through a mesh-type suction filter in the low pressure oxygen inlet connection of the pump insulation box. The liquid oxygen pump is of the single cylinder, reciprocating type, and consists of a high pressure, close tolerance mated cylinder and plunger assembly. The pump is installed in a vapor-tight insulation box that is filled with high efficiency insulation. The pump compresses the liquid oxygen and discharges it under high pressure to the vaporizer assembly. High and low pressure gages and relief valves are installed to monitor and relieve excessive pump pressures.

Vaporizer Assembly

Liquid oxygen under pressure from the pump is piped to a flow reversing valve panel on the vaporizing assembly which serves to control the direction of flow of liquid oxygen and gaseous oxygen through the heat exchanger coils. The heat exchanger in the vaporizer assembly con-


VAPORIZER ASSEMBLY
HIGH PRESS GASEOUS OXYGEN GAGE
MASTER VALVES
HIGH PRESS GASEOUS OXYGEN GAGE
CHARGING MANIFOLD
SHIFT VALVE PANEL
HIGH PRESS GAS MANIFOLD
HIGH PRESS RELIEF VALVE
LOW PRESS RELIEF VALVE
LOW PRESS GAGE
HIGH PRESS GAGE
LIQUID PUMP DRAIN VALVE
LOW PRESS OXYGEN GAGE VALVE
HIGH PRESS OXYGEN GAGE VALVE

AM.591

Figure 5-1.—Portable high pressure liquid oxygen vaporizing unit.

sists of a vane axial fan and annular wound heat exchanger coils. The fan supplies ambient air to the coils which transfer the heat of the air to the liquid oxygen as it is being forced through the coils. This transfer of energy to the liquid oxygen causes it to vaporize into a gaseous state and have its temperature raised to approximately that of the ambient air. The function of the four flow reversing valves is to defrost the coils, allowing continuous operation over long periods. High pressure gaseous oxygen is continuously being delivered to the charging manifold.

Charging Manifold

The high pressure charging manifold is divided into two master shutoff valve controlled sections. Each section is monitored by a high pressure gage. The manifold is designed to charge six cylinders at a time on each section. By opening one master shutoff valve, oxygen gas is available at six manifold shutoff valves. Each manifold valve is equipped with a fusible safety plug and a frangible disc.

Operating Controls and Instruments

The operating controls and indicating instruments and operating procedures for the portable unit and the stationary installation are identical.

NOTE: The valves installed in the liquid oxygen inlet line (figs. 5-2, 4, and 5) are in addition to the liquid oxygen container shutoff valve and used only in the stationary installation of the system.

MOTOR STARTERS.–The liquid oxygen pump motor starter and the fan motor starter are identical. Each starter has two push-button switches; the black button is START, and the red button is STOP.

VAPORIZER SHIFT VALVES.–Four diaphragm, packless, globe valves, mounted on the vaporizer shift valve panel, are used to reverse the direction of flow of oxygen through the vaporizing coils. (See fig. 5-1.) Reversing the flow becomes necessary when discharge oxygen to the charging manifold becomes too cold or visual indication shows the end of the coils are excessively frosted. Valves numbered 1 and 4 and valves numbered 2 and 3 are operated as pairs. When valves 1 and 4 are closed and valves 2 and 3 are open, oxygen flows through the coils from left to right or in the same direction as the air flow. By closing valves 2 and 3 and opening valves 1 and 4, the direction of oxygen flow is reversed through the coils (opposite airflow).

NOTE: Valves must be operated quickly and in pairs to prevent buildup of excessive pressure in the pump discharge line. Valves open and close easily and do not have to be jammed tight.

PUMP DRAIN VALVE.–The pump drain valve is a packless, diaphragm, angle valve which is used to drain all oxygen from the pump when extended periods of shutdown are required and when repair of the system is necessary. It is also used during the cooling down process to vent off vaporized liquid oxygen.

MASTER SHUTOFF VALVES.–Two manually operated high pressure, packed, globe valves are installed in the charging manifold. They direct the flow of oxygen gas to the manifold valves. By opening one valve and closing the other, six cylinders may be alternately charged from each half of the manifold.

MANIFOLD VALVES.–Twelve manually operated high pressure, packed, angle valves are installed on the charging manifold. The control oxygen gas flow to each pigtail and attached cylinder. A frangible disc and a fusible plug are incorporated in each valve as overpressure safety devices.

PUMP VENT AND PRIMING VALVE.–A pump vent and priming valve is installed in the low pressure outlet line to the low pressure oxygen gage and relief valve. It is used to vent vaporized liquid oxygen during initial startup, when the pump is being cooled down.

LOW PRESSURE LIQUID OXYGEN RELIEF VALVE.–A bronze, spring-loaded relief valve is installed on the gage panel. It is set to relieve the pump jacket, inlet line, and vent line from pressures in excess of 90 psi.

HIGH PRESSURE RELIEF VALVE.–A bronze, springloaded relief valve, installed on the gage panel, is set to relieve pump discharge pressure in excess of 3,100 psi.

GAGE SHUTOFF VALVES.–A high pressure, packed, brass needle valve is installed in the line to each liquid oxygen pressure gage. These valves are used to shut off pressure to the gages if it becomes necessary to replace the gages during system operation.

INLET LINE SHUTOFF VALVE.–A bronze, packed, globe valve having an extended stem is stored in the toolbox and is used in conjunction with the portable unit. When used, this valve is installed in the low pressure liquid oxygen inlet line to the pump. It is used to control the flow of liquid oxygen from the liquid oxygen storage container.

INLET LINE RELIEF VALVE.–A bronze, spring-loaded relief valve, stored in the toolbox, is installed in the low pressure liquid oxygen inlet line, using the bronze tee provided. This relief valve is to be installed between the liquid oxygen container outlet valve and the inlet line shutoff valve and prevents excessive pressure from trapped liquid oxygen between these two valves.

HIGH PRESSURE LIQUID OXYGEN GAGE.–This gage is flush mounted on the gage panel and indicates discharge pressure of liquid oxygen from the pump. The gage is graduated from 0 to 4,000 psi with 50 psi increments.

LOW PRESSURE LIQUID OXYGEN GAGE.–This gage is flush mounted on the gage panel and indicates suction or supply pressure of liquid oxygen to the pump. The dial is graduated from 0 to 100 psi.

CHARGING MANIFOLD PRESSURE GAGES.–These gages are installed on the charging manifold to indicate pressure of oxygen gas being charged into the cylinders. Each gage dial is graduated from 0 to 4,000 psi with increments of 50 psi.

OPERATION

To insure trouble-free operation of the pump, it is essential that the interior of the pump and inlet piping be absolutely free from moisture before the initial starting procedure. The poppet type discharge valve (8, fig. 5-2) in the pump will stick if the least bit of moisture is present. Even traces of moisture can cause the pump plunger to "freeze" in the cylinder since the clearance between plunger and cylinder is very close.

Preliminary Purging Procedure

Preliminary purging must be performed prior to operation of the system if the liquid oxygen pump is being put into operation for the first time or the system has been open to the atmosphere.

Oil-free nitrogen or gaseous oxygen is used to eliminate the moisture. Any moisture can cause the pump plunger to freeze in the cylinder. Once properly purged and the pump sealed it is not necessary to purge the system again. Plates containing detailed purging procedures are usually attached to the unit or can be found in the Maintenance Instructions Manual.

After purging disconnect the source of air or nitrogen and reconnect the pump inlet line to the liquid oxygen container outlet. Install the cylinder cover nut handtight only and tighten the moisture seal clamp on the nut. Close shift valve No. 3 and reconnect the tube to the valve. Close the pump vent and priming valve. Open the liquid oxygen container shutoff and vent valves.

Starting, Normal Operating, and Shutdown Procedures

The initial startup requires a longer period of time than subsequent starts. The detailed procedures for starting, normal operation, and shutdown can be found in the Handbook of Operation-Service and Repair Instructions with Parts Breakdown, NavAir 19-5-501. The procedures listed should always be followed whenever the FY-1200 Vaporizing System is operated.

MAINTENANCE

Maintenance of the system is limited to periodic inspection which includes the following: Cleaning and replacement of the pump suction filter adjusting the pump plunger head, adjusting for valve packing leaks, and replacement of packings and damaged parts. Detailed procedures for the performance of periodic inspections can be found in NavAir 19-5-501.

LIQUID OXYGEN STORAGE TANKS

After the air separation process and accompanying liquefaction of atmospheric gases have been accomplished, equipment must be available to store and subsequently transfer the fluids to wherever they are to be used. The sizes of liquid oxygen storage tanks vary from as little as a quart to capacities approaching a million gallons. The larger tanks, over 28,000 gallons, are fixed nonmovable storage containers. Few Navy requirements involve containers over 2 000 gallons, so the design features and practices described in the text apply generally to all capacities, the main emphasis being on tanks of 2,000 gallons and under. Figure 5-3 illustrates a 2,000-gallon-capacity storage tank.

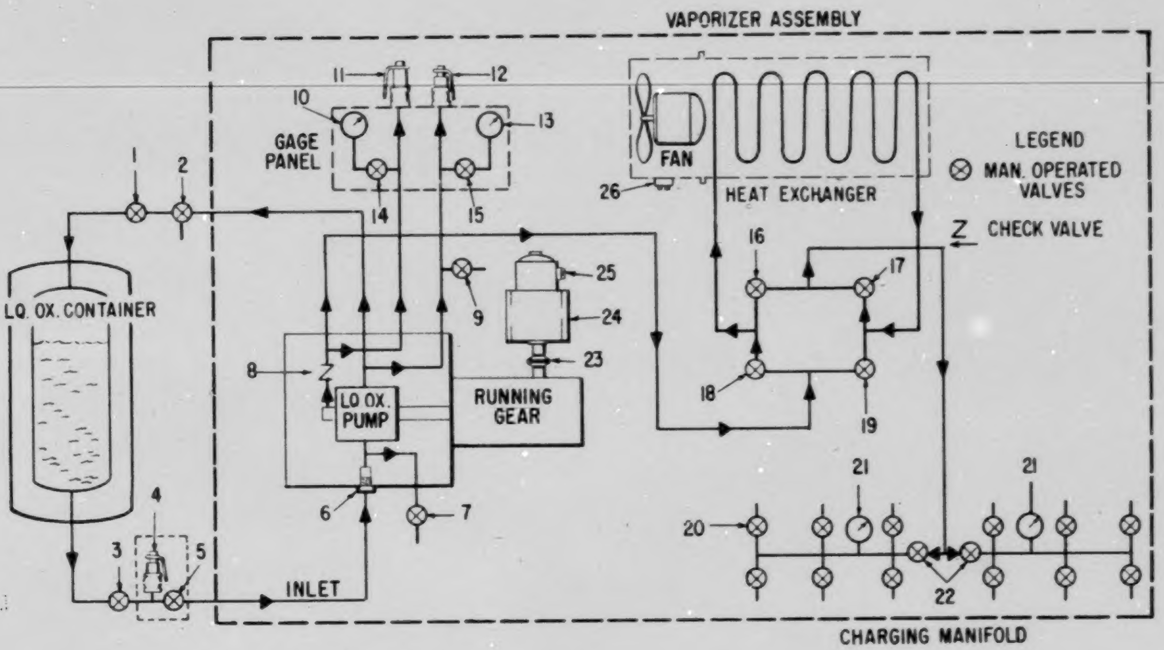
SAFETY PRECAUTIONS

WARNING: Observe all safety precautions given here to assure safe and easy handling of cryogenic liquids.

The following precautions must be observed when handling liquid oxygen.

1. Never allow liquid oxygen to contact the skin. The extreme low temperature of the liquid quickly freezes the area and severe frost bite results. If the skin is splashed with the cold liquid, immediately flush the area thoroughly with water and then obtain first aid.

2. Always store liquid oxygen with the vent valve open. Relief valves furnished on the tank


VAPORIZER ASSEMBLY
11
12
10
13
GAGE PANEL
14
15
FAN
26
HEAT EXCHANGER
LEGEND
⊗ MAN. OPERATED VALVES
Z CHECK VALVE
1
2
16
17
25
24
9
LQ. OX. CONTAINER
8
LQ OX. PUMP
RUNNING GEAR
23
18
19
21
21
20
4
3
5
6
7
INLET
22
CHARGING MANIFOLD

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1. Container vent valve.
2. Vapor return line vent valve.
3. Liquid oxygen container shutoff valve.
4. Inlet relief valve.
5. Inlet line shutoff valve.
6. Pump suction filter
7. Liquid oxygen pump drain valve.
8. High pressure liquid oxygen pump discharge valve.
9. Oxygen pump vent and priming valve.
10. High pressure liquid oxygen gage.
11. High pressure liquid oxygen relief valve.
12. Low pressure liquid oxygen relief valve.
13. Low pressure liquid oxygen gage.
14. High pressure oxygen gage valve.
15. Low pressure oxygen gage valve.
16. High pressure oxygen vaporizer shift valve No. 1.
17. High pressure oxygen vaporizer shift valve No. 2.
18. High pressure oxygen vaporizer shift valve No. 3.
19. High pressure oxygen vaporizer shift valve No. 4.
20. High pressure oxygen gas manifold valve.
21. High pressure oxygen gas gage.
22. High pressure oxygen gas master valve.
23. Flexible drive coupling.
24. Gearmotor.
25. Motor starter, liquid oxygen pump.
26. Motor starter, oxygen vaporizer fan.

Figure 5-2.—High pressure liquid oxygen vaporizing system schematic.

are provided to protect the tank in case of malfunction and are not to be used as pressure regulators.

3. Never confine liquid oxygen in any piping or container without adequate safety devices. The pressure built up when the liquid expands to gas will rupture most piping, tubing, or containers.

4. Comply with all safety directives. Fifty feet has been established as the safe distance to

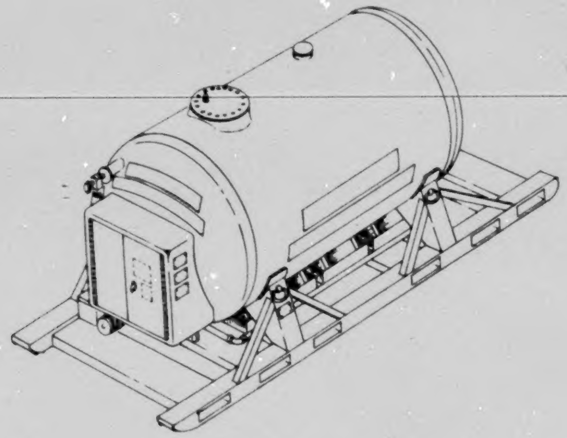

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Figure 5-3.–2,000-gallon-capacity liquid oxygen storage tank.

permit smoking, open flames or sparks in the liquid oxygen handling area. Assure painting and marking on the tank are maintained as required. Oxygen gas does not burn but it supports combustion of any material which does burn.

5. Keep liquid oxygen away from absorbent materials, loose clothing or rags. These materials can trap oxygen gas and later be ignited by a spark, cigarette, or match.

6. When liquid oxygen equipment is in use, keep it in a well ventilated area away from all gasoline, kerosene, oil, grease, and other hydrocarbons. These substances are not compatible with liquid oxygen. Spontaneous ignition may result from contact with these substances.

DESCRIPTION

All liquid oxygen storage tanks are basically similar, regardless of their size or configuration, and whether they are skid mounted, trailer mounted, or permanently installed. They all consist of an inner and outer container separated by an annular insulated space that is packed with a powder type insulating material and evacuated to a high degree in order to minimize heat transfer and thereby hold the evaporation losses to a minimum. The following major components are necessary for the proper operation of the tanks. (See figure 5-4 and table 5-1 for details.)

OPERATION

The tank is used for the storage of liquid oxygen at low pressure, with low evaporation loss, and for transferring of liquid oxygen to smaller containers as required.

Filling

Refer to figure 5-4 and table 5-1 for fill procedures. All valves except (16,18) must be closed before filling is started. Remove the cover from the fill coupling (1) and connect the source of oxygen. Open fill valve (4) and main vent valve (9) and the trycock valve (20). Open the valve on the source of liquid oxygen and transfer liquid. During the transfer of oxygen, gage (19) must be monitored to prevent overfilling. Fill valve (4) should be rotated several times during the fill operation to prevent freezing. When liquid oxygen begins to flow from the trycock valve (20), close the valve on the source. Close the fill valve (4) and vent valve (9). Open the drain valve (2) to drain the entrapped fluid, then disconnect the source from the fill coupling.

Transferring

Before transfer is started, insure that all valves except (16 and 18) are closed. Connect transfer hose (8) to the receiving trailer. Open the pressure buildup valve (14), allowing the pressure to build to 40 - 50 psig on gage (15). Manipulate the valve to maintain this pressure.

NOTE: Do not build up pressure beyond 45 psig.

Close the buildup pressure valve and open the valve on the receiving trailer. Open the transfer valve (5). When transfer is complete, close the transfer valve (5) and the valve on the receiving trailer. Open transfer line drain valve (7) and drain the entrapped liquid. Disconnect the transfer hose (8).

MAINTENANCE

Periodic maintenance includes touchup of paint, replacement of decals, and keeping the tank clean as required. For other periodic

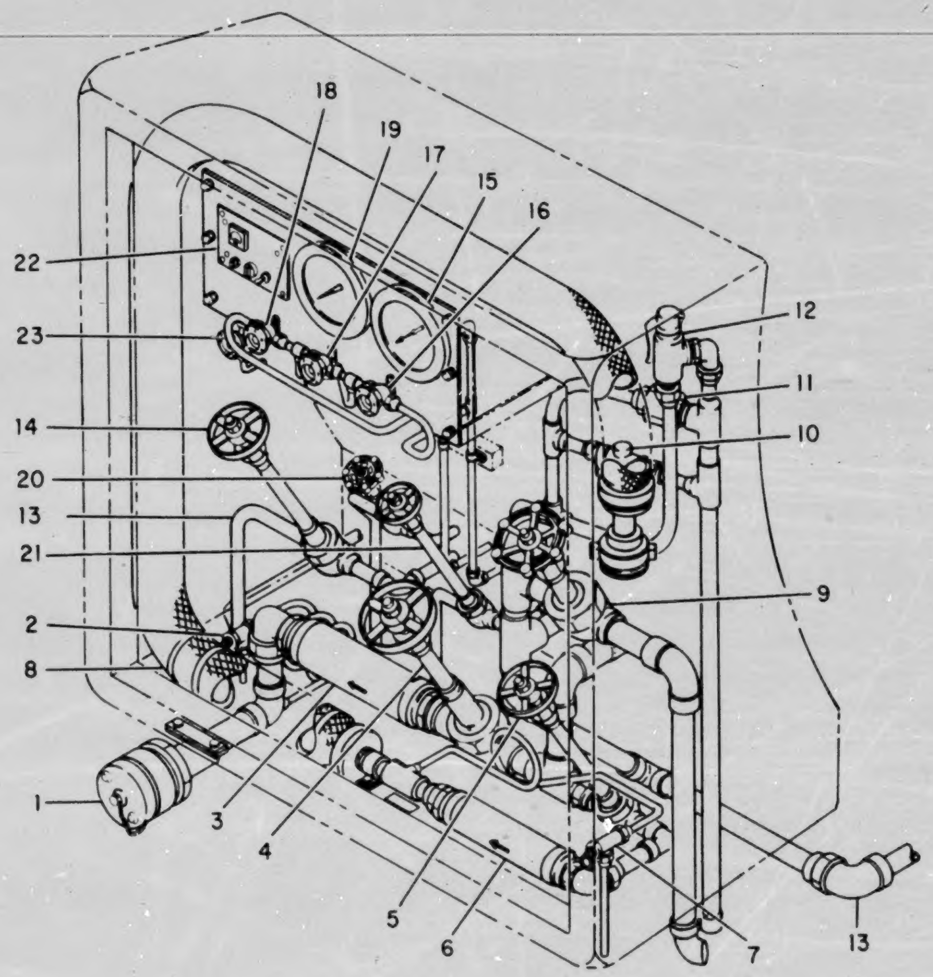
18
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Figure 5-4.—Operating controls and instruments.

Table 5-1.—Operating Controls and Instruments.

Figure 5-4 Index No.	Nomenclature	Function
1	Coupling, fill	Used for filling tank and is a standard ordnance male/female fitting.
2	Valve, drain, fill line	For draining fill line after servicing.

Table 5-1.–Operating Controls and Instruments.–Continued

Figure 5-4 Index No.	Nomenclature	Function
3	Filter, fill line	10 micron nominal, 40 micron absolute. Filter used to remove filterable solids from cryogenic liquid during filling operation.
4	Valve, fill	Used for normal filling of tank. Can also be used for draining of tank.
5	Valve, transfer	Used for normal withdrawal of liquid.
6	Filter, service line	10 micron nominal, 40 micron absolute. Used as secondary filter to decontaminate liquid on withdrawal.
7	Valve, drain, transfer line	Used to drain service hose (8) after withdrawal.
8	Hose assembly, transfer	Used for withdrawal of liquid and servicing of other equipment.
9	Valve, main vent	Used to reduce inner tank pressure. Valve may be cracked open to prevent excess pressure build-up.
10	Valve, relief, vent line	Relieves pressure when inner tank pressure exceeds 50 psig.
11	Burst disc, assembly	Operates when valves (10, 12) fail to operate. Disc ruptures at 87 psig.
12	Valve, relief	Relieves inner tank pressure when pressure exceeds 55 psig and valve (10) fails to operate.
13	Pressure buildup, line	Liquid is vaporized in coils. Pressuriced gas is admitted to vapor space in tank to pressurize liquid.
14	Valve, pressure build-up	Admits liquid to pressure buildup coils. Thereby controlling pressurization of vapor in inner tank.
15	Gage, pressure	Used to read vapor pressure in inner tank. Graduated from 0 to 100 psig.
16	Valve, isolation, liquid level gage	Used to admit pressure to liquid level gage (19) when valve (17) is closed. Valve is open at all times except during calibration of gage (19).

(This table continued on page 143)

maintenance, refer to table 5-2. Periodic lubrication is accomplished by greasing all cabinet door hinges with kel-F90, manufactured by Minnesota Mining and Manufacturing, St. Paul, Minnesota, or equivalent (no known government specification) as required.

RELATED COMPONENTS

At this point, after having described various items of equipment used to store, transport, or otherwise handle liquid oxygen, some discussion should be devoted to the means available for transferring liquid oxygen from one point to another. Piping or transfer lines must be of a different type than that used for more conventional higher temperature fluid. They will differ in several important respects; for example, some form of insulation usually is required, and the materials of construction and the joining methods must be compatible both with the extreme low temperature encountered and the chemistry of the fluids being moved. Any discussion about equipment used to transfer liquid oxygen would be incomplete without attention being directed to valves.

Transfer Lines

Aside from certain large fixed facility piping, most liquid oxygen systems are made up of transfer lines–often segmented (in sections) for ease of demountability where one transfer system can service several pieces of equipment. Generally what is said for insulation of tanks is applicable to other similar equipment with the exception of transfer lines. Transfer lines are another story, however, being cooled and warmed many times during the course of a day. The waste of liquid oxygen due to cooldown losses can be significant and with the additional advantage of easier handling, the lighter the insulation can be for equivalent thermal efficiencies the more economical the line will be to use.

With this reasoning and from this standpoint, high-vacuum insulated transfer lines should be best of all since no insulation cooldown mass is involved. However, certain compromises should be made among cooldown losses, steady-state transfer losses, degree of vacuum (if any) required and initial procurement cost, to arrive at a proper choice for a specified mode of operation. High vacuum generally is best for quick, frequent transfers; however, several wraps of multilayer insulation adds very little mass to the system and decreases the thermal radiation and requires less vacuum in the insulation annulus.

Transfer lines are most commonly constructed of bronze, stainless steel, or aluminum. In the case of vacuum-jacketed lines, annular spaces are necessary to prevent the inner liquid-bearing line from touching the outer jacket wall. Low thermal conductivity materials are used for this purpose and schemes are incorporated into the spacer design to provide only small area contact wherever possible, since the heat influx is to be kept low.

Although rigid lines often are used in stationary facility piping installations and for some demountable applications, the predominant type for use in the field is corrugated flexible metal hose. (See fig. 5-5.)

Flexible hose is somewhat more vulnerable to abuse than its rigid counterpart and therefore is usually provided with a braided metallic covering or tough plastic sheath over the external corrugations. High working pressure capability of the inner line requires the application of a strengthening braid over it as well. Even though such protection provides a certain degree of reinforcement to the hose, it should not be subjected to over-pressurization in service since a bellows-like action still may be possible if the covering is not securely fastened at the end connections. High pressure expands the hose axially, causing it to grow by lengthening the distance between each corrugation, which makes the line more rigid and therefore less flexible.

A vital consideration in all transfer line construction is the matter of joints between line segments.

Assuming that the transfer lines are vacuum-jacketed to the general region of the joint, the concern with the joint and the closure of the vacuum-jacket in close proximity to the joint is important. The bayonet coupling in figure 5-6 is one of the better designs available today and the most expensive.

In the safe and efficient use of transfer lines, several things must be considered. Liquid never should be trapped in a line between closed valves unless it is absolutely certain that some type of

Table 5-1.–Operating Controls and Instruments.–Continued

Figure 5-4 Index No.	Nomenclature	Function
17	Valve, balance, liquid level gage	Valve is opened only when valves (16, 18) are closed. Used to balance gage bellows pressure to permit checking gage (19) for zero reading.
18	Valve, isolation, liquid level gage	Valve is identical to valve (16) for kind and function.
19	Gage, liquid level	Gage is calibrated in U.S. gallons and indicates volume from 0 to 2100 gallons.
20	Valve, full trycock	Valve serves as an overflow during fill operation and indicates tank is filled to capacity.
21	Valve, drain	Used to drain cryogenic liquid from tank or emit purge gasses during decontamination of inner tank.
22	Gage and panel assembly, vacuum	Assembly records vacuum level of annular space. Level is read on gage that is calibrated 0 to atmos. in microns Hg ABS.
23	Valve, isolation, vacuum gage	Used to isolate vacuum gage (22).

relief device is functionally associated with the inner line. The reason is that the liquid will vaporize, the vapors will warm and excessive pressures can develop which possibly may burst the conduit walls.

As far as efficiency in transfer goes, it should be clear by now that vacuum-jacketed lines with well-designed low heat input couplings are optimum for most uses. Indiscriminate use of two or three transfer sections coupled together where one could do the job is wasteful of liquid and time, since several times as much line material has to be cooled down and several times more heat transferring line surface area is contacted by the cryogen. Additional heat influx means additional vaporization of the liquid and therefore requires more liquid to satisfy a given transfer demand.

Valves

Although valves might appear to be of minor concern in a system, low temperature valves often cause more trouble and grief than any other element of the system. In addition to the general requirements for any valve, liquid oxygen valves must be able to function properly at extremely low temperatures without causing excessive boil-off losses to the liquid flowing through them. The best method of meeting these thermal considerations for such valves is through insulation. Several materials have been used for insulation; however, the most effective method is to have the valve vacuum-jacketed. The valve illustrated in figure 5-7 is typical of this type. The method of operation will vary by manufacturer.

Table 5-2.—Periodic Maintenance

Component	Figure 5-4 Index no.	Frequency	Action
Valve, relief	10	Every 6 months	Test to see if valve relieves at 50 psig by pressurizing tank. Close valve (9), open valve (14). Pressurize tank to 50 psig. Valve should relieve. If valve fails to relieve, adjust valve by adjustment screw, until valve relieves.
Valve, relief	12	Every 6 months	Turn screw in to increase release pressure. Close valve (9). Open valve (14). Pressurize tank to 55 psig. Valve should relieve; if valve fails to relieve, unscrew nut until valve relieves. Allow pressure to relieve through valve. Valve should reseat at 49 psig, failure to reseat indicates weak spring. Replace spring. Readjust valve (10) to relieve at 50 psig.
Gage, pressure	15	Every 6 months	Recalibrate
Gage, liquid level	19	Every 6 months	Recalibrate
Gage, vacuum	22	Every 6 months	Recalibrate

OXYGEN SERVICING EQUIPMENT

In this section oxygen servicing equipment for both liquid and gaseous oxygen systems are discussed. Since AME's operate this equipment, they must be familiar with purging and sampling procedures as well as operation of the equipment while servicing aircraft oxygen systems.

LIQUID OXYGEN SERVICING TRAILERS

The primary purpose of portable transfer equipment is to provide a means of servicing oxygen systems installed in aircraft. A general description of one piece of transfer equipment for liquid oxygen servicing is given in this section, with particular emphasis being placed on maintenance of the trailer and contamination control of the contents.

The liquid oxygen servicing trailer shown in figure 5-8 is the type NO. 4, manufactured by Ronan and Kunzel. It is typical of equipment currently in use and therefore has been selected for coverage in this training manual. Other liquid servicing trailers are similar in operation, except the TMU-70/M.

Liquid oxygen is stored in the servicing trailer at its boiling point by controlling the heat

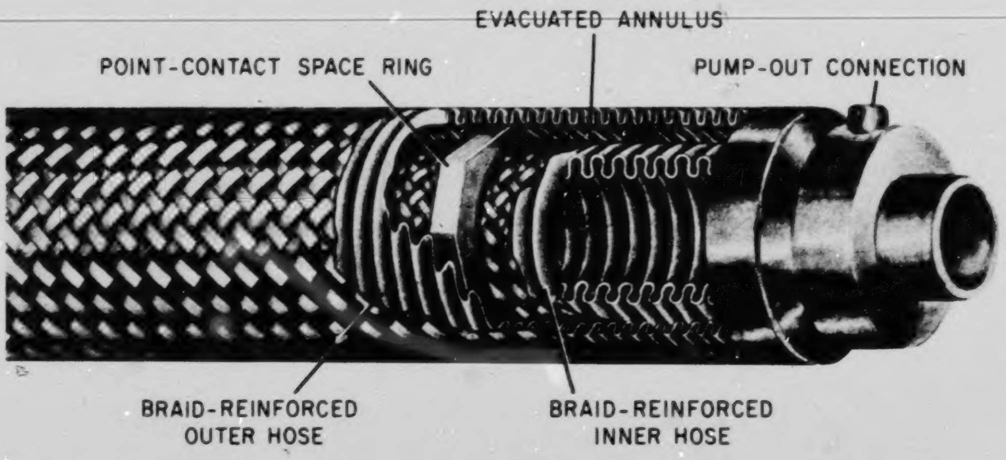
EVACUATED ANNULUS
POINT-CONTACT SPACE RING
PUMP-OUT CONNECTION
BRAID-REINFORCED OUTER HOSE
BRAID-REINFORCED INNER HOSE

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Figure 5-5.—Flexible metal transfer hose.

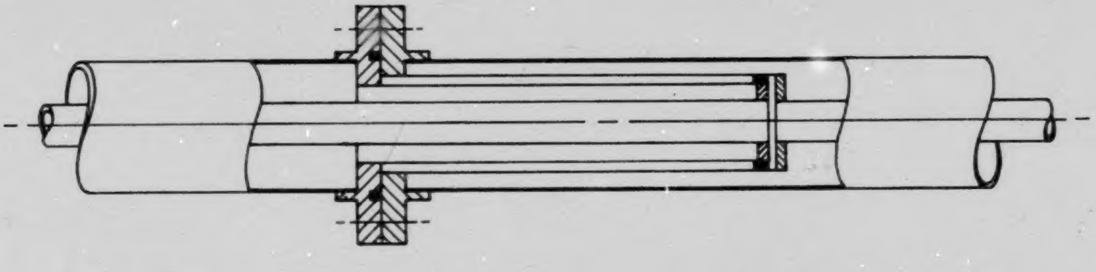

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Figure 5-6.—Transfer line connector/coupling.

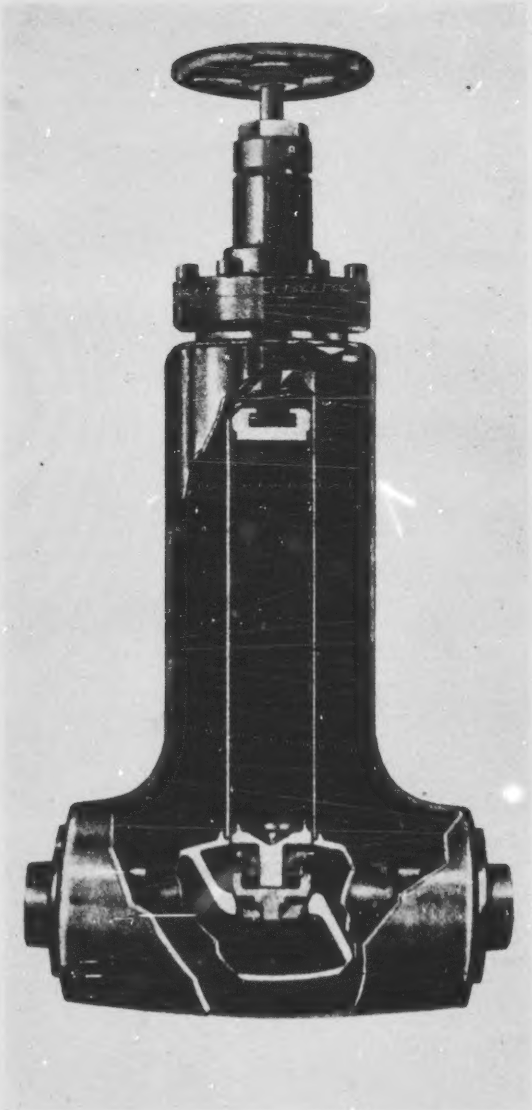

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Figure 5-7.—Vacuum-insulated cryogenic globe valve.

entering the tank and boiling the liquid. There is a slight boiling at all times as all the heat leaking in by radiation and conduction cannot be eliminated. This slight boiling governs the evaporation rate or liquid loss. The evaporation rate or liquid loss (by volume) varies with the total capacity of the tank.

Maintenance

Figure 5-9 schematically portrays the arrangement of valves, lines, gages, discs, and tanks as they apply to the type 4 liquid oxygen servicing trailer. Figure 5-10 illustrates the control hood arrangement.

A battery-operated thermocouple gage is used to measure the vacuum in the air-evacuated, insulated space between the tank and the jacket. The vacuum in this space is measured in microns on the gage (1,000 microns equals 1 mm Hg pressure and 760 mm Hg equals barometric pressure at sea level). The batteries are located in a plug-in battery pack behind the gage.

NOTE: If the trailer is used in humid or below freezing temperatures, the batteries should be removed from the gage when not in use. The battery pack can be carried by the operator and plugged into the gage for operation.

The vacuum is measured as follows: With the battery pack plugged in, batteries connected and tube plugged into the socket on the cable from the gage, depress switch 4 (fig. 5-10), and hold down. Then depress and hold down button 3 (fig. 5-10) and observe the needle swing across the dial. Use adjusting knob 6 (fig. 5-10) to balance the needle at zero. Then release button 3, and read the microns of pressure (vacuum) in the insulated space. Release switch 4 after each use. This adds to the service life of the element and battery.

Periodic lubrication is required only on the moving parts of the trailer running gear. Lubricate according to the instructions contained in the applicable equipment manual.

Other maintenance includes replacing of transfer hose and fill-drain line filter discs. If used daily, filters should be changed every 3 months, or whenever they appear to impede the flow of liquid.

Both filters are removed by unscrewing the retaining bushing and compressing a lockring, after which the filter may be removed for inspection. After removal, either clean with trichlorethylene and let air dry, or replace with a new filter.

The installation procedure is the reverse of the removal procedure with the following exceptions. Prior to the reinstallation of the bushing, apply a light coat of oxygen seal, Specification

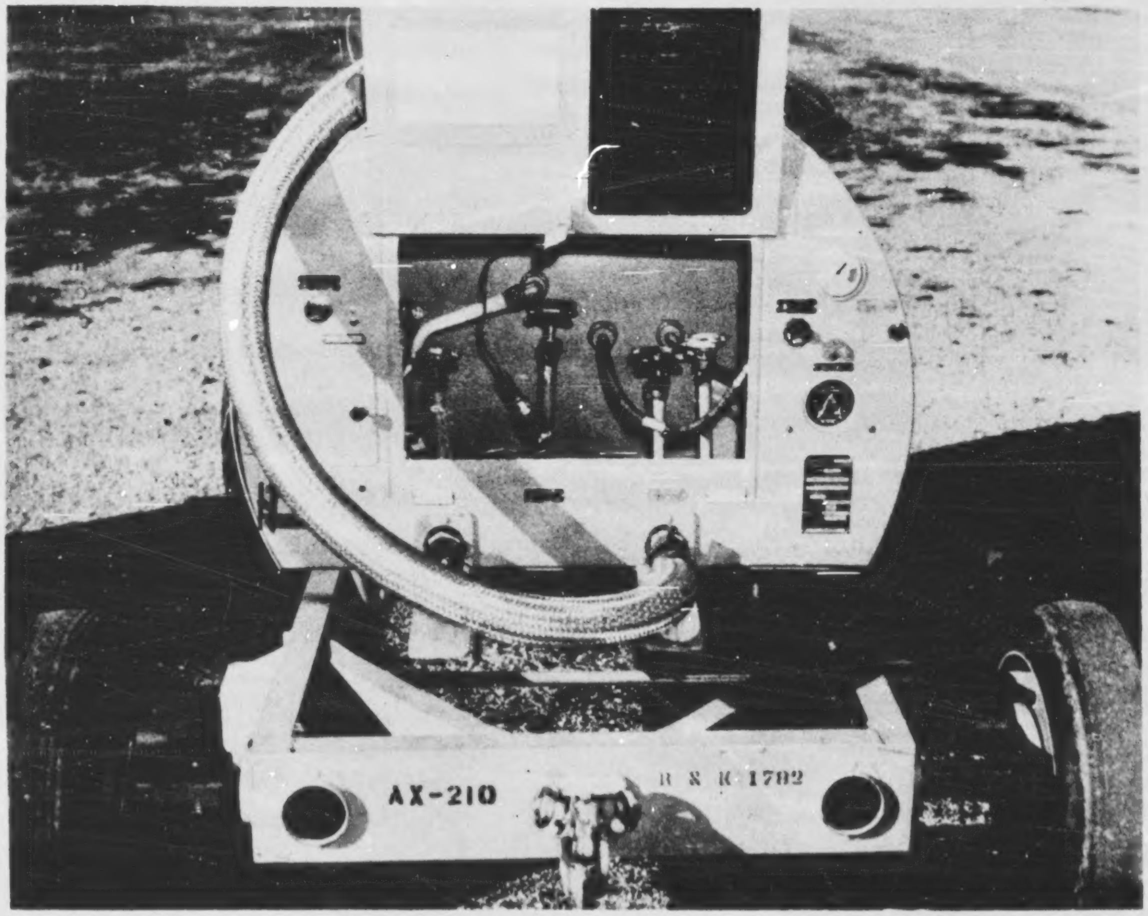

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Figure 5-8.–Typical 50 gallon liquid oxygen servicing trailer.

MIL-T-5542D, to the male threads. When applying, leave the leading threads bare to avoid introducing foreign material into the system. Replace the bushing and its attached parts.

Close the fill-drain valve, and pressurize the section of piping containing the filter with gaseous oxygen to eliminate moisture. If required, it may be necessary to attach an adapter fitting on the fill-drain line outlet, in order to pressurize the piping section. Connect the fill-drain outlet with the pressure system and bring pressure up to 60 psi. Cover threaded connections with a bubble soap solution or other leak test compound. Any bubbles at the connection indicate leaks which must be sealed before the assembly is used.

TROUBLESHOOTING.–Probably the greatest amount of time expended toward maintenance of the liquid oxygen servicing trailer is in troubleshooting. Table 5-3 is a list of discrepancies, together with some probable causes and a remedy for each cause.

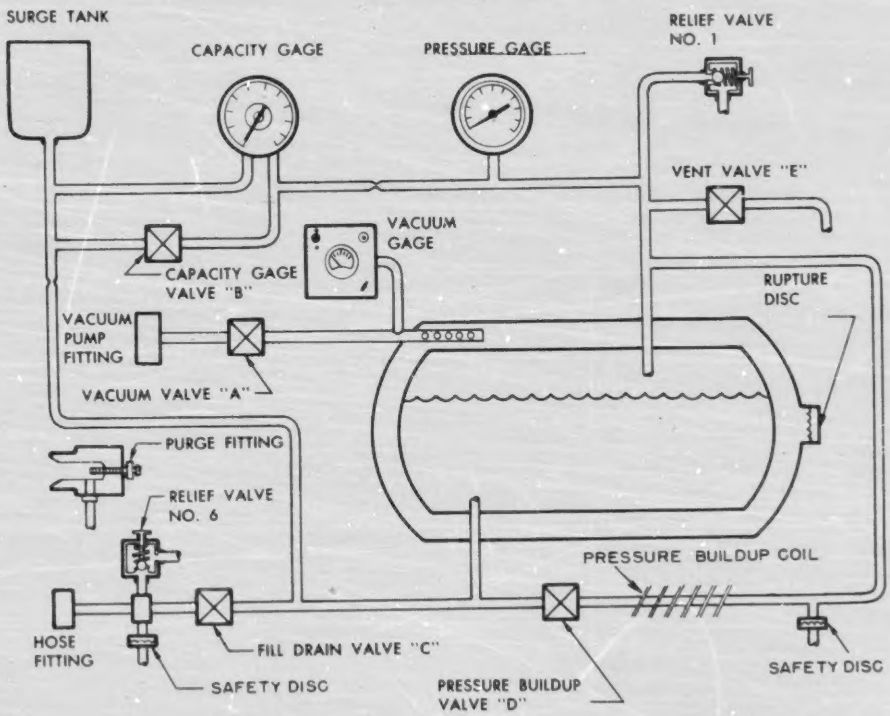
SURGE TANK
CAPACITY GAGE
PRESSURE GAGE
RELIEF VALVE NO. 1
VENT VALVE "E"
VACUUM GAGE
CAPACITY GAGE VALVE "B"
RUPTURE DISC
VACUUM PUMP FITTING
VACUUM VALVE "A"
PURGE FITTING
RELIEF VALVE NO. 6
PRESSURE BUILDUP COIL
HOSE FITTING
FILL DRAIN VALVE "C"
SAFETY DISC
PRESSURE BUILDUP VALVE "D"
SAFETY DISC

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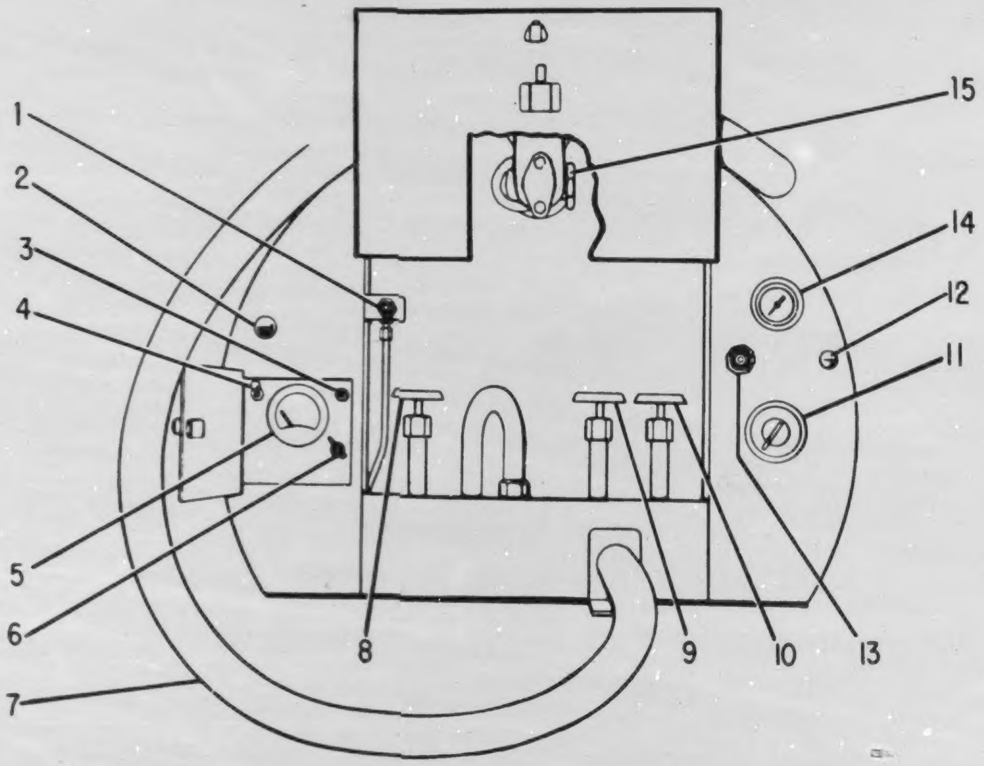
Figure 5-9.—Liquid oxygen servicing trailer tank (schematic).

VACUUM PUMPING INSULATED SPACE.—When vacuum exceeds 250 microns, with liquid in the tank, a pumpdown is required. The vacuum pump type PMU-216 is recommended for servicing the equipment. The operation and maintenance of this pump is covered in the next section of this chapter.

For best results, before a tank is vacuum pumped, it is recommended it be empty of liquid and allowed to warm (60°-70°F) for maximum efficiency and quality of the pumping operation. It is necessary that all valves be in a closed position and the tank held under a slight pressure (3-5 psi). This will prevent any circulation of air within the tank, and eliminate the possibility of moisture laden air from condensing on the inner walls and the subsequent formation of water in the bottom of the tank. For proper warming, the tank should stand for a minimum period of 5 days.

With the tank warmed and ready for a pump-down, remove the blank plate and its O-ring from the end of the vacuum valve. Using a male fitting, lightly coat with vacuum wax. Then connect the vacuum pump hose over the male fitting and secure with a hose clamp. Lightly coat a new O-ring with vacuum wax and bolt to the male fitting on the end of the vacuum valve. Tighten to assure metal to metal contact. Cover the exposed end of the vacuum hose on the fitting with vacuum wax.

Before opening valve A (fig. 5-9), start the vacuum pump and evacuate the air in the hose until it has reached a vacuum of at least 250 microns. Check connections between the pump and tank for leaks. When the 250-micron reading



1. Purging device.
2. Tank pressure relief valve 1.
3. Button.
4. Switch.
5. Vacuum gage.
6. Knob.
7. Transfer hose.
8. Vent valve E (red).
9. Fill-drain valve C (blue).
10. Pressure buildup valve D (white).
11. Capacity gage.
12. Hose pressure relief valve 6.
13. Capacity gage valve B (black).
14. Pressure gage.
15. Vacuum valve A (yellow).

Figure 5-10.—Control hood arrangement of liquid oxygen servicing trailer.

Table 5-3.—Troubleshooting chart.

Discrepancy	Probable cause	Remedy
Restriction of flow while transferring liquid oxygen.	Frozen or foreign material obstructing filter in tank fill-drain line or hose.	Check system to find obstruction and clean, thaw, replace, or repair as necessary.
	Ice in hose or filler valve.	Same as above.
Inability to build up pressure to transfer liquid oxygen.	Insufficient amount of liquid oxygen in tank.	Refill.
	Lines or pressure buildup coil extremely cold.	Allow to warm up.
	Vent valve not completely closed.	Close.
	Plumbing leak.	Tighten or repair as necessary.
	Pressure relief valve (12) leaking.	Push control knob for positive manual closing. If still leaking, replace.
	Ruptured safety disc in buildup coil safety head.	Replace.
	Obstruction in liquid system lines.	Find obstruction, clean or repair as necessary.
Hose safety disc blows when pressure gage shows less than 100 psi.	Pressure relief valve (12) has failed to operate. When fill-drain valve is closed, pressure gage indicates tank pressure only. Pressure in hose and line may have been built up from liquid oxygen in hose.	Check pressure relief valve.
Hose safety disc or pressure buildup coil safety disc blows at less than 100 psi.	The applicable pressure relief valve has failed to operate.	Check pressure relief valve.
	Rough edges on inner edge of pipe contacting rupture disc.	Smooth edges to 1/64-inch radius.
	Safety disc not positioned in center of passageway.	Be sure new safety disc is placed over exact center of line.
	Faulty pressure gage.	Replace pressure gage.
Loss or apparent loss of vacuum.	Punctured rear dome rupture disc.	Replace insulation and rupture disc. Pump the vacuum.
	Vacuum valve not tightly closed.	Tighten and wire in closed position.

Table 5-3.—Troubleshooting chart—Continued.

Discrepancy	Probable cause	Remedy
Fill-drain, pressure build-up, vent or top valve does not allow passage of liquid oxygen or gaseous oxygen.	Defective valve.	Replace valve.
Capacity gage malfunction.	Capacity gage valve sticks or will not close tight enough to afford a workable pressure on the gage.	Replace valve.
	Valve leaks through pack nut or through seat and disc.	Tighten nut or replace valve as necessary.
	Excessive leaking in hood plumbing.	Tighten loose connections.
	Plugged orifice.	Replace.
	Foreign material or ice in plumbing.	Clean out.
	Defective gage.	Replace.
Pressure gage malfunction.	Vibration has lodged needle on wrong side of peg.	Remove face and correct needle. Bend slightly if necessary.
	Defective gage.	Replace gage.
	Ice or foreign material in line.	Remove line and clean.
Leaks around safety discs.	Rough sealing surfaces around safety discs.	Recondition and replace as necessary.
	Safety disc not positioned in center of passage.	Replace disc, being sure it is placed over exact center of line.
Pressure relief valve does not open above 110 psi.	Pull rod or handle binds.	Make necessary adjustments.
	Defective valve.	Replace valve.
Pressure relief valve (12) opens at less then 100 psi.	Defective valve.	Replace valve.
Pressure relief valve (12) does not open above 110 psi.	Pull rod or handle binds.	Make necessary adjustments.
	Valve improperly adjusted.	
	Defective valve.	Replace valve.

is indicated in the hose, remove the safety wire from the valve and slowly open a quarter turn at a time. This will prevent a sudden rush of air from packing the insulation tightly against the filter located in the insulated space. With the use of any vacuum pump having a capacity not less than 12 cfm, the pumpdown procedure given below is recommended.

NOTE: This procedure applies to tanks having a vacuum reading in excess of 250 microns, as well as those whose vacuum space has been exposed to atmospheric pressure, with the exception of the TMU-'70/M portable transfer trailer.

The procedure consists of a 3-hour pump, followed by 72-hour wait, followed by 2-hour pump. Since the insulation in the vacuum is of cellular composition, it will not release the air trapped in its cells, except under a partial vacuum over an extended period. Therefore, it is necessary to maintain the recommended waiting period after first pumpdown.

When vacuum pumping is completed, close vacuum valve A before stopping the pump. Rewire valve A in its closed position. Remove the male fitting and the O-ring. Install a new O-ring lightly coated with vacuum wax and replace the blank plate over the valve coupling. Tighten until metal-to-metal contact is obtained.

Fill the tank with liquid oxygen. Then take a reading on the vacuum gage. The gage indication should not exceed 250 microns to insure adequate vacuum for the proper operation of the tank.

NOTE: Prior to filling with liquid oxygen the vacuum reading will not normally be below 1,000 microns, since that is the low limit for a warm, empty tank. After the tank is filled with liquid, it may require up to 3 days before the vacuum reading stabilizes and an accurate reading can be obtained.

Logbook

Present directives require that a log be maintained on each and every piece of liquid oxygen ground servicing equipment. Minimum information to be contained in this log is as follows:

1. Type and serial number of equipment.
2. Dates equipment was received and put into service.
3. Date and quantity of commercial deliveries and the receiver tank used.
4. Date and quantity of liquid oxygen transferred to each servicing trailer.
5. Number of aircraft serviced from each trailer load of liquid oxygen.
6. A continuing record of dates when equipment was purged.

It is advisable to record the bureau numbers of all aircraft serviced with each load of liquid oxygen since, in the event of contamination, these must be furnished in the report to NavAirSysCom.

Contamination Control

Liquid oxygen must be handled with extreme care at all times due to its high affinity for most forms of contamination. A contaminated supply may cause noxious and nauseating odors which adversely affect pilot proficiency and cause malfunction of liquid oxygen equipment. For these reasons, all personnel working with liquid oxygen ground support equipment and aircraft systems should take every possible precaution to maintain the quality of the liquid oxygen supply and to prevent contaminants from being introduced into the supply at any time.

Detection

Liquid oxygen contamination is detected by means of an odor test, sampling and analysis, and pilot complaint. The odor test in the following paragraphs may be used to detect gross contamination, whereas the exact amount and kind of contamination is determined by a laboratory analysis of the liquid oxygen sample.

The odor test should be made on liquid oxygen systems after every dry purge or wet cleaning and at such other times as contamination is suspected. The test on liquid oxygen trailers is made as follows:

1. Cover the botton of a 400-cu cm beaker or similar container with a clean, dry piece of filter paper or other suitable absorbent paper. (See fig. 5-11.) Provide a clean watchglass cover or some other means of partially covering the top of the beaker. This cover is required to prevent odors from the surrounding atmosphere from being absorbed into the liquid oxygen sample.

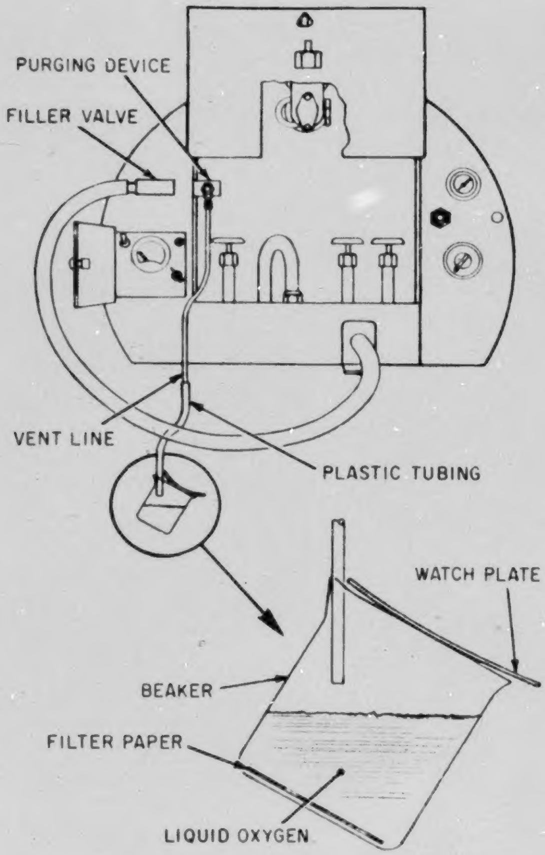


Figure 5-11.–Collecting a liquid oxygen sample from a servicing trailer.

2. Connect a short section of clean plastic tubing to the vent line of the trailer purging device. This will aid in collecting samples in the beaker.

3. Connect the filler valve of the trailer transfer hose to the purging device and purge the hose for at least 2 minutes.

4. Collect approximately 200 cc of liquid oxygen in the beaker. Keep the beaker covered as much as possible, both while collecting the sample and during the remainder of the test.

NOTE: Do not hold the beaker with bare hands while collecting the sample.

5. Allow the sample to evaporate to dryness in an area free of air currents or any odors.

6. After the sample has evaporated, raise the cover and smell the vapors in the beaker. The frost which collects on the outside of the beaker may also give off odors as it melts.

7. If odors are detected in the liquid oxygen sample, purge the equipment as specified in NavAir 06-30-501 or other appropriate maintenance manuals.

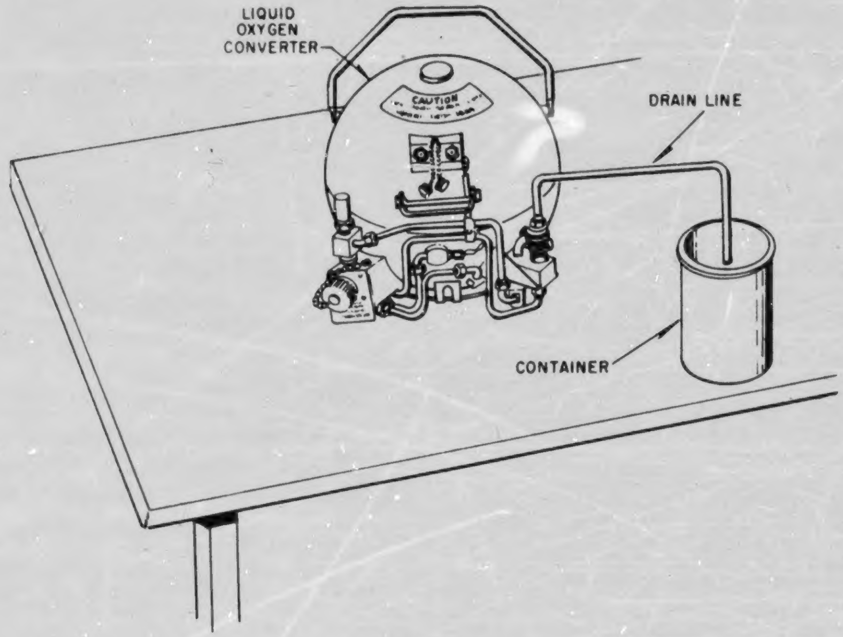
Taking samples of liquid oxygen from converters installed in aircraft is generally not practical nor desirable. If a converter suspected of containing unsuitable oxygen cannot be removed from the aircraft because of lack of time or other reason, it is best to purge the system and take a sample from the trailer or storage tank that originally supplied the aircraft.

If the converter is not installed in the aircraft, the operations necessary to cause liquid oxygen to flow into the beaker can be determined from the Maintenance Instructions Manual for the particular aircraft involved. One manufacturer recommends attaching a clean, rigid U-shaped metal line to a spare supply disconnect coupling and attaching this assembly to the supply disconnect connection of the converter as illustrated in figure 5-12. This line serves to deflect the liquid oxygen from the supply line downward and into the beaker.

NOTE: When draining a liquid oxygen converter, insure that the area is open and free of personnel and that fire extinguishing equipment is readily available. The immediate area around the converter and draining area must be free of any grease, oil, or other combustible material. In addition, insure that all components used to fabricate the drain line assembly are free of any oil, grease, or other hydrocarbons.

Purging

Purging is a procedure to remove contaminants from containers by flushing out the contents of the container with hot, dry, gaseous nitrogen or oxygen. One of the principal contaminants is moisture, which may short the converter probes. The purging gas is heated so that any moisture in the container will be removed. Under existing instructions, purging is



AM.585

Figure 5-12.—Collecting a liquid oxygen sample from an aircraft converter.

authorized to be accomplished by cognizant personnel at fleet level.

To purge a storage tank or trailer, drain all liquid oxygen from the container and open vent valves. If time permits, allow the trailer to warm to ambient temperature. This will conserve large quantities of gas, but will take from 2 to 4 days for a 50-gallon trailer tank and 4 to 6 days for a 500-gallon storage tank.

Connect the heater and a source of dry gaseous nitrogen to the top-fill line. Open the fill valve. If the tank has no top-fill connection, connect to the fill-drain line and vent through the vent valve.

Pass hot nitrogen through the tank at moderate flow for at least 2 hours. The temperature of the exit gas should be at least 100°F, or in accordance with purging equipment instructions, before concluding the purge. If equipment for measuring water-vapor content and personnel trained in its use are available, test the outlet gases for moisture content. If gases do not meet moisture requirements, continue purging.

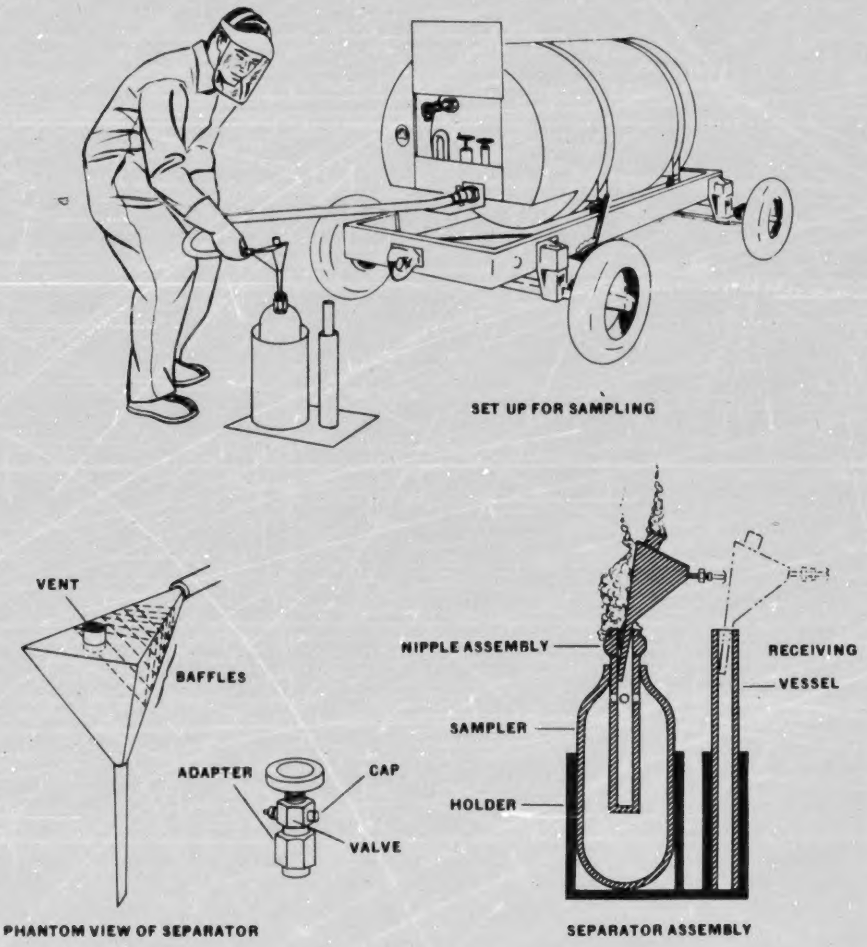
NOTE: If the special equipment or trained personnel are not available, the heat and time provisions of purging, followed by an odor test, should prove adequate in the field.

Test outlet gas for the presence of odors. If any odors are present, continue purging. If odors persist after extensive purging, arrange for the equipment to be cleaned by a Depot maintenance activity. If the purging is satisfactory, stop the nitrogen flow and close all tank valves.

SAMPLING.—In order to exercise rigid control over the quality of liquid oxygen, class A naval air stations have been equipped with special spectrophotometer analytical equipment. These stations monitor their own liquid oxygen production, storage, and handling procedures as well as these at the manufacturer's plant and at designated secondary naval activities.

The manufacturer's storage tank from which deliveries are to be made should be sampled prior to delivery and at least once each 90 days during the period the manufacturer supplies the oxygen to the Navy. Where no deliveries are made directly from the generator or when there are no storage facilities, the first delivery and every fourth thereafter should be sampled. The frequency of sampling servicing trailers and storage tanks depends upon the purging program and upon the frequency of use, but in no event later than every 60 days or whenever contamination is evident or suspected.

Figure 5-13 illustrates the equipment and the setup for sampling. Samplers are prepared at Depot maintenance activities and shipped to the using activities as required. The sampler preparation includes: The separation of valve, adapter, and cylinder; baking and evacuating the cylinder


SET UP FOR SAMPLING
VENT
BAFFLES
ADAPTER
CAP
VALVE
PHANTOM VIEW OF SEPARATOR
NIPPLE ASSEMBLY
SAMPLER
HOLDER
RECEIVING
VESSEL
SEPARATOR ASSEMBLY

AM.600

Figure 5-13.—Sampling.

for 1 hour, flushing once with gaseous oxygen; and, finally while still in the oven and still evacuated, the cylinder is filled to 20 psi with gaseous oxygen. The valve is then closed and the cap installed, in which condition it is shipped to the using activity.

There are several precautions that should be observed incident to sampling. Observance of these precautions will help to insure a representative sample. Do not sample from a trailer hose. Use only a short connection between the tank and sampler. A few feet of copper tubing, three-eights inch in diameter, attached directly to the tank drain outlet, or trailer fill-drain outlet, is recommended by current directives. All flare fittings must be perfect—without dents, scratches, or toolmarks. Do not use any antiseize compound on threads or any cleaning compounds on sampler parts. Contamination will result. A sampler received without residual pressure probably leaks. Such samplers should be rejected and returned.

Just before sampling, remove the cap from the sampler valve; open the valve to release shipping gas pressure, then reclose. Next, remove the valve by disconnecting the adapter from the nipple and place the cylinder upright in a holder.

Attach the separator and line assembly to the tank drain or fill-drain outlet. Using a trailer pressure of 10 to 20 psi let the liquid oxygen flow into an open container, such as the receiving vessel shown in figure 5-13, for at least one-half minute in order to purge the line. Adjust the pressure to obtain a quiet, uniform, full flow from the separator outlet tube.

Wipe the frost from the separator outlet tube and immediately insert the outlet into the sampler tube and fill it. The filling will take approximately 1 minute. When liquid splashes in droplets over the top, the tube assembly is full. The sampling tube holds about 180 cu cm of liquid oxygen, which produces a maximum pressure of 300 psi when vaporized in the closed sampler.

NOTE: During the filling operation, the operator should wear a face shield, hat, gloves, and other protective equipment as excessive pressure will violently evolve liquid oxygen from the tube assembly.

As soon as the sampler tube is filled, remove the separator from the sampler assembly and install the adapter to the cylinder. Close it tightly with end wrenches, making sure that the valve is fully closed. Turn sampler upside down for a few minutes to allow liquid to flow from the sampler tube into the cylinder. Immerse the valve of the cylinder in water to check for leaks.

Fill in the attached tag (fig. 5-14), noting date of sample, identification of source, date taken, date container cleaned, container identification, capacity of container and quantity being sent. On the reverse side, fill in the type analysis requested and the reason for analysis; then ship the sampler to the designated test station.

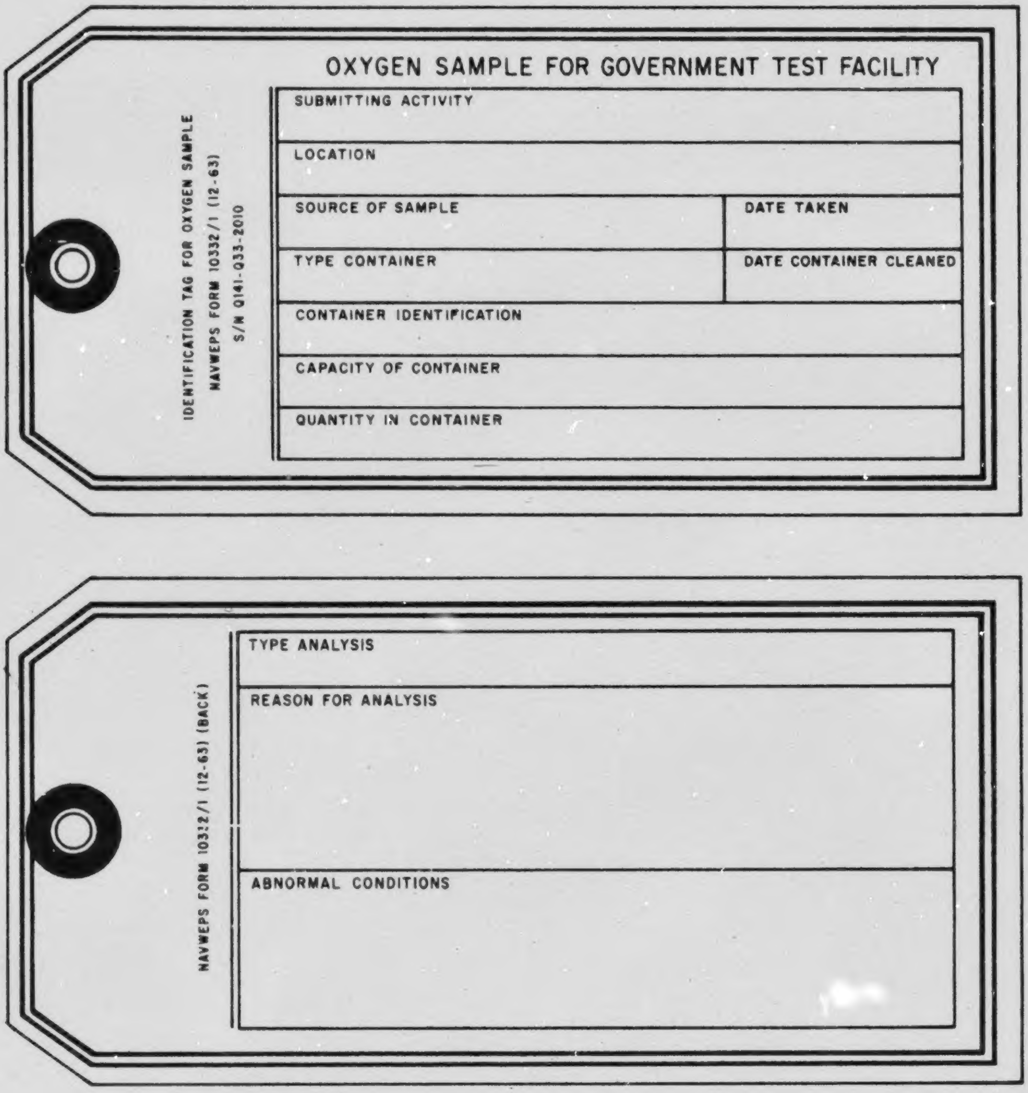
WET CLEANING.—Wet cleaning of liquid oxygen (LOX) containers is not recommended. When purging by nitrogen does not result in proper cleaning, furnish details to the cognizant NAVAIRSYSCOMREP and request instructions for disposition of the tank.

REPORT OF CONTAMINATION.—A report of the contamination containing the following information should be sent to the Commander, Navail Air Systems Command.

1. Source of liquid oxygen, location of generating plant, and date suspected oxygen was delivered.
2. Aircraft affected, including bureau numbers, brief history of the aircraft, and flights in which the oxygen was used.
3. Information listed in the liquid oxygen servicing equipment log.
4. Effect of odors on crew.
5. Results of crew's blood analysis.

TMU 70/M, LOW LOSS, CLOSED LOOP LIQUID OXYGEN SERVICING TRAILER

During liquid oxygen servicing of aircraft converters considerable loss of oxygen occurs as a direct result of the manner in which the transfer is carried out. In addition to the economic loss, a safety hazard is created when liquid oxygen or oxygen vapors are released to the atmosphere near operating equipment and personnel. To alleviate these problems, the low loss closed loop system has been devised which significantly reduces liquid oxygen transfer losses and eliminates the safety hazards associated with venting oxygen in critical areas.



OXYGEN SAMPLE FOR GOVERNMENT TEST FACILITY

IDENTIFICATION TAG FOR OXYGEN SAMPLE
NAVWEPS FORM 10332/1 (12-63)
S/N 0141-033-2010

SUBMITTING ACTIVITY	
LOCATION	
SOURCE OF SAMPLE	DATE TAKEN
TYPE CONTAINER	DATE CONTAINER CLEANED
CONTAINER IDENTIFICATION	
CAPACITY OF CONTAINER	
QUANTITY IN CONTAINER	

NAVWEPS FORM 10332/1 (12-63) (BACK)

TYPE ANALYSIS
REASON FOR ANALYSIS
ABNORMAL CONDITIONS

AM.1225

Figure 5-14.—Instruction tag for oxygen sampie.

Description

The TMU 70/M, Low Loss, Closed Loop, Liquid Oxygen Servicing Trailer is shown in figure 5-15. It is a completely self-contained unit having three major components: a 50-gallon dewar tank, a 15-liter dewar transfer tank, and a low loss, closed loop (LLCL) system of transfer lines. Separate liquid level and pressure gages as well as pressure relief devices are provided for each tank.

These components are permanently mounted on a portable three-wheel trailer, equipped with a manually operated parking brake and retractable caster wheel. The TMU 70/M is manufactured by Cryogenic Engineering Co.

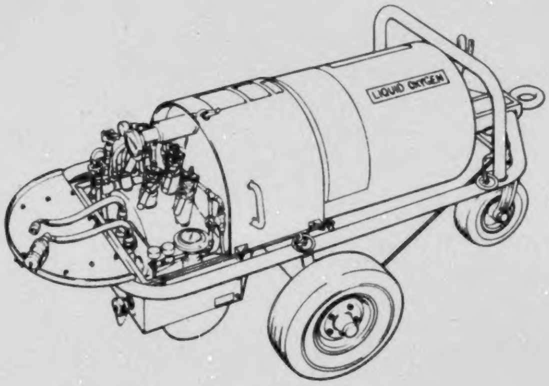


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Figure 5-15.—TMU 70/M Low Loss, Closed Loop, Liquid Oxygen Servicing Trailer.

The primary purpose of the TMU 70/M is the servicing of aircraft liquid oxygen (LOX) converters. The low loss, closed loop transfer system (LLCL) is designed to retain oxygen vapor caused by heat losses during transfer to the aircraft converter. The gaseous oxygen vapors being vented from the transfer tank and aircraft converter are returned to the storage tank for cooldown and retention.

STORAGE TANK.—The storage tank is a 50-gallon (U.S.) capacity, double walled dewar. The space between the double walls of the storage tank and the transfer tank is evacuated down to 5 microns or lower and contains a multilayer, high vacuum insulation to minimize heat gain and boiloff of the liquid oxygen.

TRANSFER TANK.—The 15-liter-capacity transfer tank is a double walled vacuum-insulated dewar, and permanently attached to the storage tank. It is self-contained and gravity filled from the storage tank. The transfer tank is equipped with a pressure buildup coil, relief valve, rupture disc, and controls. The primary function of the transfer tank is to hold small volumes of liquid oxygen and to utilize cold gas pressure from the pressure buildup unit for the purpose of transferring this liquid oxygen to the aircraft converter.

TRANSFER LINES AND PIPING SYSTEM.—These lines carry the liquid oxygen from the storage tank to the transfer tank and then to the aircraft converter. They also carry the vented oxygen gas from the aircraft's converter to the storage tank.

The closed loop system of the transfer lines contains the vented oxygen gas during filling operations. The interconnected liquid and return gas lines are vacuum jacketed wherever practical and are of minimum length to reduce cooldown and heat leak losses.

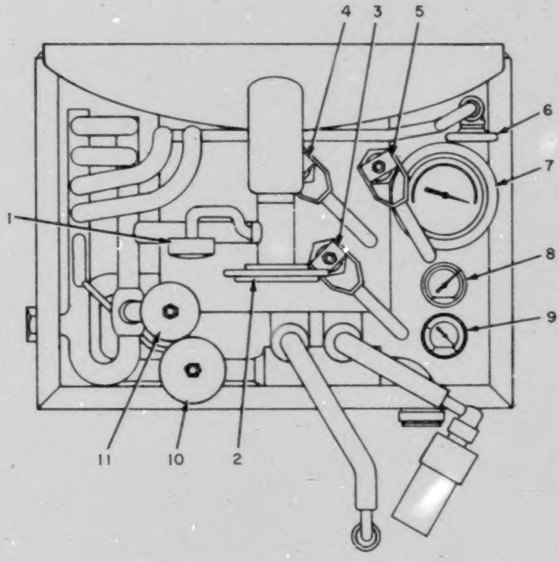
The piping system consists of a fill line for storage tank filling, a vent system for overboard venting of excess liquid or gas, and a pressure relief valve system which is connected to the vent system.

CONTROL AND INDICATORS.—The controls and indicators of the TMU 70/M are illustrated and identified in figure 5-16. Storage tank pressure gage (1) indicates the pressure in the inner tank. Storage tank liquid level gage (2) indicates the level of liquid in the inner tank when the tank is on level ground. The dial is magnetically and mechanically coupled to a float sensor inside the storage tank and is calibrated in gallons. The transfer tank pressure gage (8) indicates the pressure in the transfer tank. This pressure must be more than that of the storage tank to effect transfer of liquid since the converter is vented into the storage tank during converter filling. The transfer tank liquid level gage (7), which reads in percent full, is the same type as the storage tank liquid level gage (2) that reads in gallons. Item 9 in figure 5-16, converter full indicator gage (marked LIQUID-

GAS), is a vapor pressure thermometer that monitors the converter vent line temperature.

During transfer of liquid to a converter, it indicates "GAS" temperature in the converter vent line. When the converter is full the vent line is filled with liquid oxygen. The converter vent line temperature drops and the gage indicator moves to the "LIQUID" position that indicates a full converter.

With the exception of the converter full indicator gage (marked Liquid-Gas) and the transfer tank liquid level gage, all gages have a green band to indicate safe operating pressures and a red band to indicate unsafe pressures.



1. Storage tank pressure gage.
2. Storage tank liquid level gage.
3. Converter vent line shutoff valve.
4. Transfer tank vent line shutoff valve.
5. Transfer tank fill line shutoff valve.
6. Transfer tank pressure buildup valve.
7. Transfer tank liquid level gage.
8. Transfer tank pressure gage.
9. Converter full indicator gage.
10. Fill-drain line shutoff valve.
11. Storage tank vent line shutoff valve.

Figure 5-16.–TMU 70/M Liquid Oxygen Servicing Trailer Controls and Indicators.

In addition to the indicators covered there are several valves in the system. The converter vent line shutoff valve (3) controls the flow of oxygen gas vapors from the converter to the storage tank and prevents loss of storage tank gas when the converter is not being filled. Transfer tank vent line shutoff valve (4) controls the flow of oxygen gas vapors from the transfer tank to the vapor space of the storage tank.

The valve used to control the gravity flow of liquid oxygen to the transfer tank from the storage tank is the transfer tank fill line shutoff valve (5).

The transfer tank pressure buildup valve (Item 6 in figure 5-16) controls the flow of liquid oxygen from the bottom of the transfer tank to the pressure buildup coil (PBU). The PBU coil is a heat exchanger which exposes the liquid oxygen to ambient temperatures and is converted to gas. As this conversion takes place the gas expands, and the output gas from the PBU is fed back to the transfer tank vapor space, providing the pressure to discharge the liquid oxygen to the converter.

The fill drain line shutoff valve (10) is used during the storage tank filling operation. It permits the flow of liquid oxygen from a central supply tank to the storage tank. This valve is to be opened completely during the filling function and closed after the transfer has been completed.

CAUTION: The fill-drain line shutoff valve is not used to control flow. Restricting transfer flow may create a dangerous back pressure on the supply line used for filling. Control of transfer flow should be maintained with the service valve of the central supply tank.

Storage tank vent line shutoff valve (item 11) is used to control the release of gaseous vapors from the storage tank to the vent piping manifold. This valve is open during filling to vent all pressure from the storage tank. During idle storage it is also left open to vent all vapors generated by normal liquid oxygen boiloff. In flight line service, it is left closed to prevent oxygen vapor contact with flammable liquids or vapors, and prevent unnecessary loss of liquid oxygen.

Operation

The following procedures describe liquid oxygen flow in connection with filling the TMU 70/M storage tank and the servicing of an aircraft converter using the trailer. The flow description is keyed to figure 5-17. Figure 5-18 is a copy of the actual operating instructions from the plate attached to the trailer.

When the servicing trailer is received from the factory or from an overhaul activity, it is normally ready to be filled with LOX and pressurized for immediate use. The annular space is evacuated to the point desirable for a warm and empty tank. Prior to filling or pressurizing the tank, perform inspection procedures as indicated in table 5-4.

FILLING.–Normally the servicing trailer is filled from central supply tanks. These tanks have transfer hoses terminating in couplings that match the fill-drain line coupling on the trailer. Operation of the supply tank used should be in accordance with the procedures found in its operation manual.

Filling consists of the following procedure. Insure that all required safety equipment is in use and all safety precautions have been taken. Place the trailer on a level surface or insure that the tank has a level attitude. Close all control valves on the storage tank. Pressurize the LOX supply tank to the required pressure for transfer to the TMU 70/M. Remove the dust covers from the supply tanks transfer line and purge hose. After purging, connect the fill-drain line coupling (1, fig. 5-17) to the transfer hose. Open the TMU-70/M's storage tank vent line shutoff valve (5) and fill-drain line shutoff valve (3).

Caution: Pressure should not be allowed to rise above 55 psig in the storage tank. Monitor storage tank pressure gage (7) closely during cooldown.

Open the service valve on the supply tank slowly and allow only a partial flow of LOX through the transfer hose and into the trailer. Considerable vaporization will take place until the transfer hose, fill-drain line, and storage tank on the trailer have cooled down. When sufficiently cooled and able to handle a full flow of LOX, open the service valve on the supply tank completely.

During filling, LOX flow is through filter (2) and shutoff valve (3) to the storage tank. Relief valve (4) is provided to prevent excessive pressure if the fill-drain line shutoff valve and the service valve on the supply tank are closed with cold gas or liquid trapped within the supply line.

The relief valve (4) is connected to the vent line for safe discharge overboard. Vent valve (5) is opened during filling and normal storage where safe overboard discharge is provided. Storage tank conditions are monitored and indicated by the liquid level gage (6) and pressure gage (7).

Relief valve (8) and rupture disc (9) are provided in case of excessive pressure in the storage tank of the TMU 70/M. Monitor the storage tank liquid level gage (6) during filling. When it indicates 50 gallons or LOX starts to flow out the vent manifold, close the service valve on the supply tank. Close the fill-drain line shutoff valve (3) and relieve internal pressure.

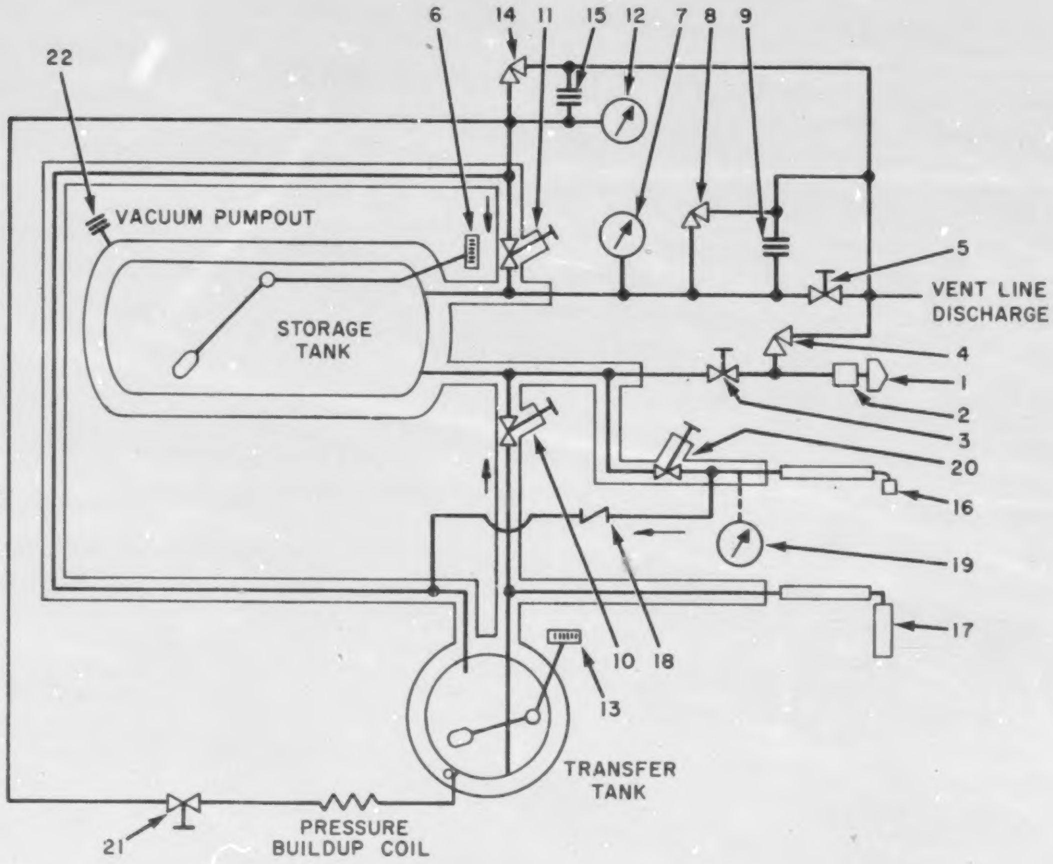
CAUTION: Use extreme caution when disconnecting the transfer hose. Even though the hose has been drained and the pressure relieved, some LOX will still remain. Do not direct the hose toward personnel or to other equipment.

Disconnect the supply tank transfer hose, immediately drain the LOX that remained, and replace the coupling cap loosely. Tighten the cap after insuring that all LOX has vaporized and bled off. Close all control valves on the service trailer except the storage tank vent valve (5).

NOTE: Observe the time required to fill the TMU 70/M. Filling will vary with each supply tank and supply line system. Under normal conditions and 30 psig transfer pressure, the storage tank should be filled within a period of 5 to 10 minutes. Abnormal deviation from the average filling time should be cause for investigation.

TRANSFER.–The transfer of LOX from the storage tank of the trailer to an aircraft converter can be accomplished by following the procedures which follow.

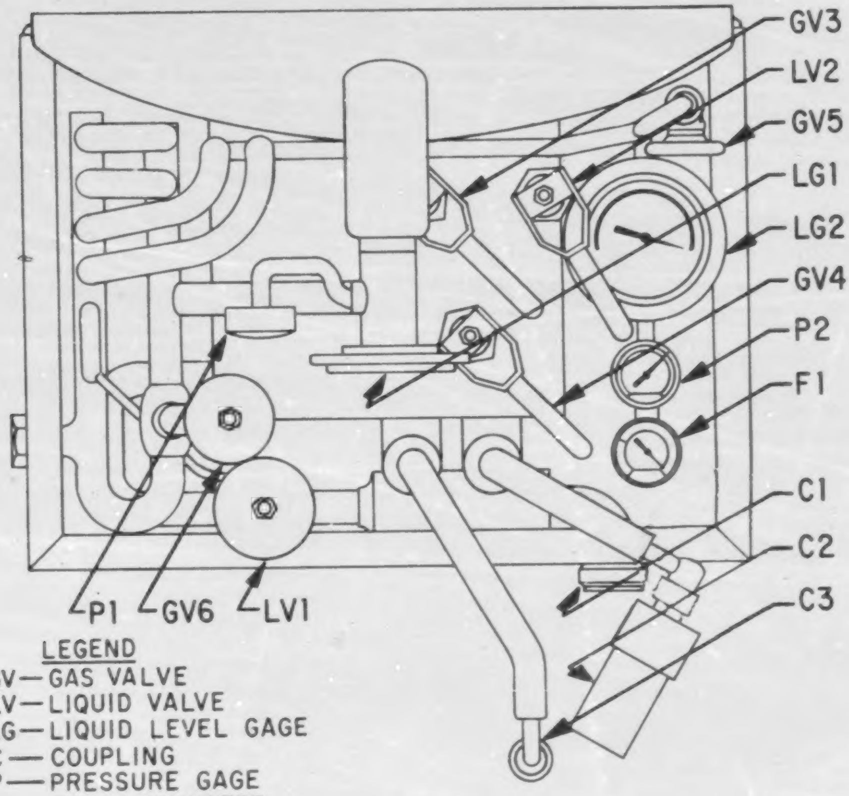
Insure that all safety equipment is in use. Close all control valves. The control valves are 3, 5, 10, 11, 20, and 21, as seen in figure 5-17. Observe storage tank liquid level gage (6) and pressure gage (7) to insure sufficient LOX supply and safe operating pressure. Open transfer tank fill valve (10) and vent valve (11); this allows the transfer tank to fill.


22
6
14
11
15
12
7
8
9
VACUUM PUMPOUT
STORAGE TANK
5
VENT LINE DISCHARGE
4
1
2
3
20
16
19
17
10
18
13
TRANSFER TANK
21
PRESSURE BUILDUP COIL

AM.595

1. Fill-drain line coupling.
2. Fill-drain line filter.
3. Fill-drain line shutoff valve.
4. Fill-drain line relief valve.
5. Storage tank vent line shutoff valve.
6. Storage tank liquid level gage.
7. Storage tank pressure gage.
8. Storage tank inner shell relief valve.
9. Storage tank inner shell rupture disc.
10. Transfer tank fill line shutoff valve.
11. Transfer tank vent line shutoff valve.
12. Transfer tank pressure gage.
13. Transfer tank liquid level gage.
14. Transfer tank inner shell relief valve.
15. Transfer tank inner shell rupture disc.
16. Converter vent line connector.
17. Air force filler valve.
18. Converter vent line check valve.
19. Converter full indicator gage.
20. Converter vent line shutoff valve.
21. Transfer tank pressure buildup valve.
22. Outer shell relief device.

Figure 5-17.–Liquid oxygen storage tank schematic diagram.



LEGEND

GV—GAS VALVE
LV—LIQUID VALVE
LG—LIQUID LEVEL GAGE
C—COUPLING
P—PRESSURE GAGE
F1—FULL INDICATOR

CLOSE ALL VALVES BEFORE STARTING ANY OPERATIONS

FILL MAIN TANK

1. CONNECT C1 TO SUPPLY TANK
2. OPEN GV6 & LV1 & OBSERVE LG1
3. WHEN TANK IS FULL CLOSE LV1 & DISCONNECT C1

FILL TRANSFER TANK

1. OPEN LV2 & GV3 & OBSERVE LG2
2. WHEN TANK IS FULL CLOSE LV2 & GV3

EMPTY TRANSFER TANK

1. OPEN GV5 & LV2 & OBSERVE LG2
2. WHEN TANK IS EMPTY CLOSE LV2 & GV5

FILL CONVERTER

1. FILL TRANSFER TANK
2. OPEN GV5 & OBSERVE P2 PRESSURIZE 80-100 PSIG
3. CONNECT C3 & C2 TO CONVERTER
4. OPEN GV4 & OBSERVE F1
5. WHEN F1 INDICATES LIQUID DISCONNECT C2
6. CLOSE GV4 & DISCONNECT C3
7. CLOSE GV5

AM.602

Figure 5-18.—Operating instructions for TMU-70/M.

When the transfer tank is full as indicated by the liquid level gage (13), close valves (10) and (11). Connect converter vent line connector (16) to the converter vent fitting. Connect the AF filler valve (17) to the converter fill fitting, using a two-step procedure. First, position the valve against the purge fitting and turn the housing clockwise, locking the valve in place. Second, push the knurled knob forward and rotate clockwise, locking the valve in the open position. Open the transfer tank pressure buildup valve (21) momentarily and observe tank pressure gage (12).

When pressure rises to approximately 90 psig, close valve (21). If necessary, maintain desired pressure by regulating valve (21) during converter servicing. Open the converter vent line shutoff valve (20) and observe converter full indicator gage (19). The gage will indicate GAS as the converter is filling and when full will indicate LIQUID.

As soon as it indicates LIQUID, disconnect the AF filler valve (17). Close the transfer tank pressure valve (21). Close the converter vent valve (20) and then disconnect converter vent line connector (16).

If no other converters are to be serviced, empty the transfer tank, open valve (10) and then valve (21), if necessary, and observe gage (13). When the transfer tank is empty, close valve (21) and then valve (10). Close all valves except the storage tank vent valve (5).

The flow of LOX from the storage tank to the aircraft converter is accomplished as follows and can be traced using figure 5-17. The flow of LOX from the storage tank to the transfer tank is by gravity. It first passes through the transfer fill line shutoff valve (10) to the transfer tank. During this process, the gaseous oxygen produced by cooldown of the tank is vented back to the storage tank through vent valve (11). Conditions of the transfer tank are monitored and indicated by pressure gage (12) and liquid level gage (13).

When the transfer tank is filled to the desired level, as indicated by the liquid level gage, valves (10) and (11) are closed. The converter lines are connected to the vent line connector (16) and filler valve (17). The filler valve is opened to allow the pressure in the converter and transfer tank to equalize. The transfer tank pressure buildup coil (PBU) is used to increase the pressure in the transfer tank to approximately 90 psig. This pressure is regulated by the pressure buildup valve (21) as required to maintain as high a pressure as possible during the servicing operation.

WARNING: The rate of pressure buildup depends on the liquid level in the transfer tank. On a full tank the pressure will build extremely fast because of the small amount of vapor space to be filled. Use extreme caution in building the pressure and never allow the pressure to exceed 90 psig. If observation of the rate of pressure buildup indicates it will exceed 90 psig, open transfer tank vent valve (11) to relieve the excessive pressure into the storage tank. This will avoid the opening of the relief valve (14) and the resultant undesirable discharge of gaseous oxygen from the vent line.

LOX is now able to flow from the transfer tank into the converter. When the converter full indicator gage (19) indicates full, the overflow is returned to the storage tank by passing through the converter vent line shutoff valve (20). The filler valve (17) is then removed, the transfer tank pressure buildup valve (21) is closed, vent valve (20) is closed, then vent line connector (16) is disconnected.

The preceding process is repeated until the storage tank is either empty or the maximum operating pressure, as indicated on storage tank pressure gage (7), has been reached.

MAINTENANCE

Information and instructions for maintenance of the Type TMU 70/M Low Loss, Closed Loop, Liquid Oxygen Storage Tank, can be found in NAVAIR 19-25D-26. The Maintenance section in this manual is organized to provide information and instructions for the three levels of maintenance responsibility: Organizational, Intermediate, and Depot.

The capability of the using or supporting activities will be the limiting factors as to the level of maintenance that can be performed on the equipment. If maintenance of the equipment is beyond the assigned maintenance responsibility of the using or supporting activity, the next higher level of maintenance activity will perform the maintenance.

Organizational Maintenance

Organizational maintenance includes those functions normally performed by the operating activity in support of its own operations. Normal operational maintenance functions include inspection and preventive maintenance. Tables 5-4 and 5-5 will assist in understanding these functions.

PERIODIC INSPECTION.–Table 5-4 lists the inspections and the required frequency of performance.

PREVENTIVE MAINTENANCE.–This type maintenance entails periodic lubrication, exterior cleaning, and operational checkout. Table 5-5 lists periodic lubrication and required frequency of performance. Exterior cleaning is performed in the following steps: Visually inspect all exterior surfaces for such contaminants as oil, grease, metal chips, or scale. Use an ultraviolet light to check couplings, vent line, converter, and storage tank fill lines and and surrounding areas for presence of hydrocarbons. Cleaning of the exterior may be done with pressurized steam to remove contaminants if care is taken to insure moisture is not introduced into the storage tank and piping.

Table 5-4.–Periodic Inspection.

Item	Inspection	Frequency
Exterior	Inspect for obvious physical damage, missing parts, illegible decals or plates, and missing or insecure attaching parts.	Daily while in use.
Piping and valves	Inspect for dents, nicks, or scratches; security of brazed or threaded connections; ease of valve movement and adequate seating and security of packings.	Daily while in use.
Gages	Inspect for cracked dial face and security of installation.	Daily while in use.
Cabinet	Inspect for smooth hinge and guide operation and correct functioning of latches and legibility of decals and plates.	Daily while in use.
Tires	Inspect for correct inflation, tread wear, sidewall cracks or abrasions, and proper positioning of valve stems.	Daily while in use.
Wheel assemblies	Inspect for warps or dents in rims and freedom of rotation.	Daily while in use.
Retractable caster	Inspect for proper operation and undue wear or damage.	Daily while in use.
Controls	Inspect for loose, missing, or cracked handles; obvious physical damage.	Daily while in use.

Table 5-4.–Periodic Inspection.–Continued

Item	Inspection	Frequency
Brake and cross shaft assemblies	Inspect for physical damage, missing parts, and ease of operation.	Daily while in use
Converter fill and vent line hoses	Inspect for frayed wire in braid and worn or damaged fill and vent couplings.	Daily while in use.
Exterior cleanliness	Inspect visually for such contaminants as oil, grease, metal chips or scale.	Daily while in use.
	Inspect with ultraviolet light for presence of hydrocarbons.	Weekly.
Operation	Perform operational checkout.	Monthly or on receipt of new or repaired equipment.

Table 5-5.–Periodic lubrication.

Part	No. of points	Lubricant	Frequency
Wheel bearing	4	Pack bearings with grease (MIL-G-10924	Yearly
Retractable caster assy	3	Grease (MIL-G-10924). Use pressure gun.	Monthly
Caster locking pin assy	1	Lubricating oil (Spec. VV-0-471)	Monthly
Brake lever assy	13	Lubricating oil (Spec. VV-0-471)	Monthly
Brake cam	2	Lubricating oil (Spec. VV-0-471)	Yearly

OPERATIONAL CHECKOUT.–These procedures are a series of operations designed so each component of the unit is tested. The procedures permit a full evaluation of the system to detect equipment trouble before malfunctions become severe enough to result in total equipment failure. Refer to the Technical Manual, NAVAIR 19-25D-26, for details of the check on each component.

TROUBLESHOOTING.–The following information contains procedures for identifying malfunctions encountered during operational checkout. This information appears in tabular form in table 5-6, and should insure a complete understanding of the most common problems encountered during operation and operational checkout of the equipment.

Intermediate Maintenance

Intermediate maintenance is the responsibility of and is performed by designated maintenance activities in support of the using organization. Maintenance that does not require entry into the liquid oxygen or vacuum systems may be performed at the intermediate level. This would include the retractable caster, wheel and brake, handbrake and cross shaft, and cabinet assemblies. All functions of the organizational level maintenance may also be performed at the intermediate level.

Depot Maintenance

Depot maintenance is the responsiblity of and is performed by designated maintenance activities in support of organizational and intermediate maintenance activities. Maintenance requiring entry into either the liquid oxygen system or vacuum system must be performed at the depot level. All functions of the organizational and intermediate levels may also be performed at the depot level.

Table 5-6.–Troubleshooting Chart.

Trouble	Probable Cause	Checking Procedure	Remedy
Pressure gage indicates above normal	Pressure relief valve not operating. This is a dangerous condition and immediate action must be taken to vent the excess pressure.	Visually check pressure relief valve.	Replace valve.
	Pressure gage indicating incorrectly.	Check calibration.	Calibrate or replace gage.
	Pressure buildup valve GV-5 in open position.	Check pressure buildup valve.	Close valve.
Tank burst disc blows at less than rated pressure	The applicable pressure relief valve has failed to operate.	Check valve setting.	Replace valve.
	Incorrect or faulty burst disc.	Compare with replacement disc.	Replace disc.
	Fitting at outlet of burst disc assembly too tight causing twisting of burst disc components.	When removing burst disc note tightness of outlet fitting.	Replace burst disc assembly, do not tighten outlet fitting excessively.

Table 5-6.–Troubleshooting Chart–Continued.

Trouble	Probable Cause	Checking Procedure	Remedy
Pressure relief valves do not open above rated pressure	Pressure gage faulty or incorrectly calibrated.	Check calibration.	Perform calibration procedures. If gage cannot be calibrated, replace.
	Valve faulty or incorrectly set.	Build up tank pressure and recheck valve.	Replace relief valve.
	Valve frozen.	Visual or manual	Thaw valve.
Valve seat leaking	Valve not fully closed.		Close valve tightly. (For toggle valve, check adjustment).
	False indication. Leakage is in another part of system.	Check system carefully. Disassemble as far as possible to determine if valve is leaking.	
	Ice or foreign material lodged in valve seat.	Empty system and warm interior to ambient.	Disassemble valve and examine seating surfaces thoroughly. Dry entire system.
	Valve seat warped or worn.	Disassemble valve and examine seat thoroughly.	Replace removable seat. Lap seat if necessary.
Couplings will not mate with couplings on other equipment	Ice or other foreign material on mating surfaces.	Visual.	Thaw out and examine carefully.
	Improper couplings on mating equipment.	Check coupling applicability.	Use mating equipment or install proper couplings.
Storage tank filling time abnormally long	Central supply pressure too low or transfer line unable to deliver sufficient liquid.	Check out storage transfer system carefully. Refer to supply tank manual.	

Table 5-6.—Troubleshooting Chart—Continued.

Trouble	Probable Cause	Checking Procedure	Remedy
	Ice or foreign material obstructing fill line filter.	Remove and inspect filter carefully.	Thaw and clean or replace as required.
	Fill, vent, or supply valve not fully opened.	Check valves carefully.	See previous procedure on leaking, sticking. or hard to turn valves.
Transfer tank filling time abnormally long	Supply tank does not contain enough liquid.	Check supply tank liquid level.	Fill supply tank.
	Pressure buildup valve open.		Close pressure buildup valve.
	Supply tank not level.	Check attitude of trailer.	Level unit as required for filling.
	Transfer tank fill and vent valves not fully open or defective.	Check valve position and adjustment or disassemble and examine.	Adjust or replace as required.
	Operator using wrong filling procedure.		Repeat fill procedure following operating instructions carefully.
	Defective liquid level indicator.	See previous procedure for defective liquid level gages.	
	Liquid level in supply tank low.	Lift lunette eye while filling transfer tank. NOTE: This is a check procedure not recommended for normal operation.	
Transfer tank does not pressurize within two minutes	Transfer tank fill or vent valve open.	Check valve positions.	Close valves.
	Liquid level in transfer tank low.	Check liquid level.	Fill transfer tank as required.
	Pressure buildup line excessively frosted from recent or frequent use.	Make visual inspection.	Thaw piping or allow to warm to ambient temperature.

Table 5-6.–Troubleshooting Chart–Continued

Trouble	Probable Cause	Checking Procedure	Remedy
	Faulty Pressure gage.	Check gage calibration.	Replace gage as required.
	Transfer tank relief valve leaking.	Close storage tank vent valve and check for gas leakage into vent manifold.	Replace relief valve.
	Transfer tank rupture disc leaking or blown.	Close storage tank vent valve and check for gas leakage into vent manifold.	Replace rupture disc assembly.
	Transfer tank fill valve leaking. Transfer tank vent line valve leaking.	Close storage tank vent valve and monitor storage tank pressure gage for pressure buildup.	Drain tank, disassemble fill toggle valve, and inspect carefully for worn or damaged seat.
	Converter vent line check valve leaking.	Check for gas venting from converter vent line coupling.	Replace check valve.
	Gross external leak.	Make visual inspection of transfer tank and all piping. Make bubble check.	Repair as required.
Converter does not fill within five minutes	Pressure buildup valve not open.	Open valve fully.	
	Converter fill coupling valve not fully actuated.	Disconnect and reconnect fill coupling making sure valve is actuated.	
	Converter vent line shutoff valve not fully open.	Check for proper operation of valve.	
	Low transfer tank liquid level.	Check transfer tank liquid level.	Fill transfer tank.
	Defective converter.	Fill test another converter.	
	Defective converter full indicator.	Check operation of indicator.	Replace if defective.

Table 5-6.—Troubleshooting Chart—Continued.

Trouble	Probable Cause	Checking Procedure	Remedy
Liquid level gage does not indicate	No liquid in tank.	Verify liquid in tank.	
	Liquid level very low. (Level gage float does not float well, if at all, in liquid nitrogen because of its lower density.)		Refill as required.
	Level gage float jammed or frozen on bottom of tank.	Tap lightly on flange where level gage enters tank.	Drain tank, remove level gage mechanism and inspect carefully.
	Level gage travel stop is worn or float arm is bent.	Remove level gage dial, loosen level gage flange bolts, and shake gage to free float.	Replace parts as required.
	Level gage float gears jammed with ice or foreign material.	Remove level gage dial, loosen level gage flange bolts, and shake gage to free float.	Replace parts as required.
	Defective dial gage.	Remove dial gage and gage mount. Place gage back into position without mount. Rotate gage to check operation of magnetic coupling movement.	Replace parts as required.
	Level gage shaft or magnetic coupline defective.	Drain tank, remove gage mechanism, and operate mechanism manually. Check magnetic coupling operation.	Replace as required.

NOTE: When the liquid level gage shaft and gear assembly is removed from a cold tank, frost or condensation will form immediately. The assembly must be warmed and dried completely by heating to drive all moisture out of assembly.

PMU-216 VACUUM PUMP

The Type PMU-216, 12 CFM Motor Driven Rotary Vacuum Pump (figures 5-19 and 5-20), is a unit designed for the purpose of evacuating the annular insulating space of liquid oxygen containers to an absolute pressure of 10 microns Hg, or less, as measured with a McLeod type gage. The unit is manufactured by Vacuum Systems, Inc.

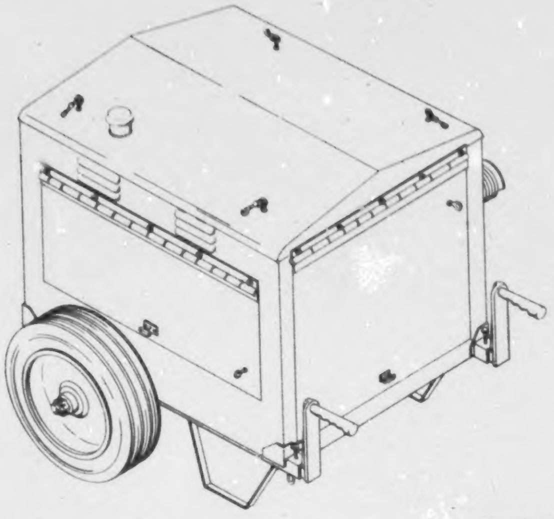


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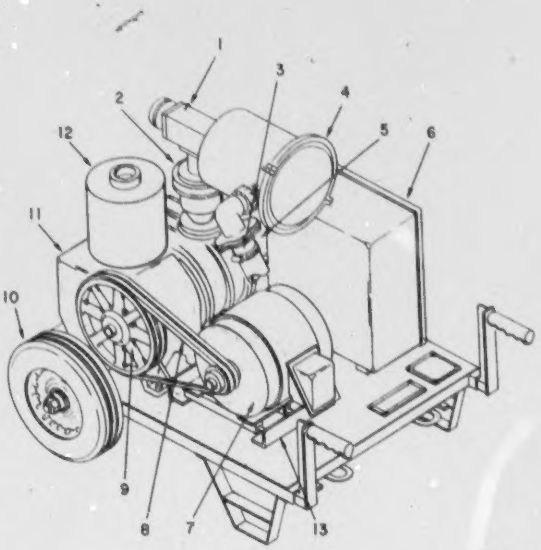
Figure 5-19.–Rotary Power Driven Vacuum Pump, 12 CFM Type PMU-216.

Principles of Operation

When the unit (Fig. 5-20) is connected to a source of electric current and the on-off switch located in switch box assembly (6) is on, the electric motor (7) applies power to the vacuum pump (11) by means of a matched pair of V-belts (8). As the driven sheave (9) rotates, rotors within the vacuum pump turn, causing two spring-loaded vanes in each rotor to sweep the inner wall of the pump housing creating a suction.



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1. **Vacuum valve.**
2. **Check valve.**
3. **Servicing line.**
4. **Filter.**
5. **Vacuum gage.**
6. **Switch assembly.**
7. **Electric motor.**
8. **V-belts.**
9. **Driven sheave.**
10. **Wheel assembly.**
11. **Vacuum pump.**
12. **Separator.**
13. **Motor mounting base.**

Figure 5-20.–Rotary power driven vacuum pump with cabinet removed.

The separator employs baffle plates to recover the vacuum pump lubricating fluid and return this fluid to the lubricant reservoir in the rotary vacuum pump. In addition the separator acts to separate the air from the lubricating fluid and provide a means of discharging air into the atmosphere through the vent in the separator.

The air evacuated from the external storage tank passes through the flexible servicing line (3) into the filter (4). The air passes from the filter through the vacuum valve (1) and the check valve into the first stage of the vacuum pump (11). This air enters the rotary vacuum pump every time the spring-loaded vane passes the intake opening in the vacuum pump. The air trapped within the rotary vacuum pump is evacuated through the separator (12) into atmosphere as the second stage sweeping vanes pass the vacuum pump exhaust valves.

COMPONENTS.–The type PMU-216, 12 CFM Motor Driven, Rotary Vacuum Pump consists of an electric motor-driven vacuum pump and control unit totally enclosed in a protective steel cabinet. The unit is mounted on two rubber-tired, semipneumatic wheels. The unit has been designed so that operation, adjustments, and repairs can be accomplished by operating personnel. The following text describes the components of this unit.

Electric Motor.–A 220/240-volt, 60-Hz, 3-phase, 1-1/2-horsepower, constant speed motor (7, figure 5-20) bolted to a mobile base, is used to drive the rotary vacuum pump (11). The motor is controlled from the switch assembly (6).

Vacuum Pump Drive Components.–A driven sheave (9) is mounted on the rotor shaft of the rotary vacuum pump. A pair of matched V-belts (8) joining the rotary vacuum pump driven sheave and the drive sheave of the electric motor is employed to transfer mechanical power.

Rotary Vacuum Pump.–The rotary vacuum pump (11) consists of two cast iron cylinder sections (first and second stage) and an end bearing plate and houses two cast iron rotors. The rotors are mounted on a common rotor drive shaft, extending through first and second stage cylinders supported by roller bearings at either end. One end of the rotor-drive shaft extends through an oil-seal mounted in the second stage cylinder to provide a means for mounting and keying the rotary vacuum pump driven sheave. Two slots are machined 180° apart on each of the two rotors. Spring-loaded vanes fit into these slots to sweep the inner surface of the cylinders when the rotor is revolving. The rotary vacuum pump, operating in conjunction with the other components, creates a vacuum as it sweeps past the intake opening in the vacuum pump cylinder.

Check Valve.–A check valve (2) mounted on the rotary vacuum pump first stage inlet prevents pump lubricating oil from entering service line in the event of power failure. The valve embodies a ball type check which restricts oil flow in one direction.

Vacuum Valve.–A vacuum valve (1) located upstream of the check valve (2) is a manually operated bellows-type valve. It provides a means of isolating the rotary vacuum pump from the storage tank being evacuated.

Separator.–The separator (12) consists of a steel tank. The separator inlet is located on the bottom of the tank and the outlet vented to atmosphere is located on the top. Steel baffle plates in the separator are employed to allow the escape of evacuated air from the rotary vacuum pump and to trap lubricant vapors carried into the separator along with the evacuated air.

Servicing Line.–Two 6-foot lengths of flexible servicing hose (3) with different inside diameters are used to connect the storage tank being evacuated to the filter inlet. The larger hose (1-5/8 i.d.) provides faster pump down and is for use with 150-gallon or larger tanks. An adapter flange is provided on each servicing line for securing the lines to the tank being evacuated.

Vacuum Gage.–A vacuum gage (5, figure 5-20) mounted on the left rear side of the mobile base is provided to enable checking the vacuum system upstream and downstream of the vacuum valve (1, figure 5-20). Accurate readings are obtainable directly without requiring an assisting gage. The vacuum gage is a self-contained instrument with the circuitry mounted on the rear of the indicating meter barrel. Three cables are attached to the vacuum gage, two for connection to the gage tubes, located on the vacuum valve, and the other for connection to the rotary vacuum pump switch assembly. The gage is operated by an ON-OFF switch located below the indicating meter. A position switch is located on the gage to enable measuring pump blankoff pressure at Station I. The other position, Station II enables measuring pressure of servicing line, filter, and the connected tank.

Safety Precautions.–The motor should never be started unless the separator vent is free from obstruction and the rotary pump servicing line is connected to the storage tank being evacuated. Operation of the rotary vacuum pump with unattached servicing line allows dirt and dust to enter the rotary vacuum pump and may cause serious damage.

Do not allow servicing line flanges to come in contact with dirt and dust. When not in use, the servicing lines should be protected with the service line hose caps provided for that purpose.

The servicing line must not be transferred from one storage tank to another without first shutting off the unit or closing the vacuum valve.

When not in use, the electrical connecting cable should be kept neatly coiled on the clips provided for this purpose on the outside of the cabinet. Avoid causing any sharp kinks in this cable as this may lead to possible fracturing of the conductor wires or the insulating covering.

The rotary vacuum pump is designed for use with tricresyl phosphate conforming to Federal Specification TT-T-656, Type II. Proper oil level must be maintained at all times to insure efficient operation and adequate protection of the equipment.

WARNING: Tricresyl phosphate oil is a poison if ingested orally. It also presents a hazard if absorbed through the skin or respiratory system. Avoid direct skin contact or prolonged exposure.

Maintenance

Maintenance which can be performed by the using organization is covered in the following text, and table 5-7 is provided to show periodic inspection requirements.

The electric motor requires little or no maintenance as it is a self-contained unit which will give long life. Care should be taken to insure that the motor cover assembly is kept clean and free of contamination of dust and dirt. Insure that all wiring is free from chafing or any form of abrasion. Check connectors daily for tightness.

To keep V-belt wear to a minimum, the driven sheave (9) must be kept in exact alignment with the motor sheave and the belts kept free from water and oil. Belt dressing is not to be used.

When it becomes necessary to remove the V-belts for replacement, it is accomplished by turning the adjusting bolt at the motor base (13), then moving the motor toward the vacuum pump. This will provide enough slack to pry each belt (8) over the driven sheave (9). Installation of new V-belts can be accomplished by reversing the removal procedure. Install the belt nearest the inside of the sheave and the motor first. Insure that both belts are evenly seated in the sheave grooves.

NOTE: When installing new V-belts, use an entirely new, matched set. Never use a mixed set of old and new, as the old belt is usually stretched and will place an uneven strain on the new belt.

Move the motor away from the vacuum pump until the correct tension is acquired. The correct tension is reached when the belt can be depressed in the middle and there is a half-inch difference between the inner and outer belt. After the correct tension has been reached, tighten the motor bolt.

Maintenance of the rotary vacuum pump filter consists of changing it periodically. This is done every 6 months or after every 100 hours of operation.

PERIODIC INSPECTION.–Table 5-7 outlines required inspections to be conducted to insure maximum operating efficiency of the PMU-216, Rotary Vacuum Pump.

TROUBLESHOOTING.–Table 5-8 contains instructions for troubleshooting the components at the Organizational level of maintenance. When any of the components require major overhaul or repair, they must be returned to the Depot maintenance organization. After determining the trouble, refer to Table 5-8 to determine the probable cause and remedy.

GASEOUS OXYGEN SERVICING TRAILER

The principles of operation of the NO 2 Oxygen Servicing Trailer together with a description of its components are provided in Aviation Structural Mechanic E 3 and 2. Therefore, discussion of the gaseous oxygen servicing trailer

Table 5-7.—Periodic Inspection.

Component	Nature of Inspection	Inspection Periods Hours		
		Daily	40	100
Motor	Check security of mounting	X		
	Check for satisfactory operation	X		
	Check for security of waterproof cable connectors		X	
V-belts	Check for uneven wear, damage or fraying	X		
Vacuum pump	Check for satisfactory operation	X		
	Check for evidence of lubricant leakage	X		
	Check oil level	X		
	Inspect flexible servicing line for damage or leaks		X	
Cabinet	Check for security of attachment		X	
	Check door latches for proper operation		X	
Steel base	Inspect for broken welds			X
	Inspect for broken or damaged mounting studs			X
Valves	Inspect for leakage at joints		X	
All parts	Inspect for excessive wear or damage		X	
Filter	Change cartridge after every 6 months or every 100 hours			X
Vacuum Gage	Check inside of gage tubes for contamination			X

in this course is limited to equipment maintenance and contamination control. Overall responsibility for maintaining oxygen ground servicing equipment in good working order is a function of the AME shop supervisor.

MAINTENANCE

The chemical drier,should be inspected after every 12 cascade cylinders are used, and the chemical agent should be replaced at the first sign of change in the indicator. The drying agent is white in color, and the indicating agent which is applied on top of the drying agent is blue in color. When moisture is present, the indicating agent will change color (from blue to pink). Inspection is easily made by removing the recharging hose and unscrewing the top cap. The drying agent can be replaced by removing the

Table 5-8.–Troubleshooting.

Trouble	Probable Cause	Remedy
MOTOR		
Fails to start	No electrical current	Check security of plug on electrical connecting cable.
	Blown or open fuse	Check for existence of electrical current at source into which electrical connecting cable is plugged.
Hums but fails to start	Improper belt tension (too tight)	Adjust V-belt tension.
VACUUM PUMP		
Faulty evacuation	Leak in flexible servicing line	Replace complete flexible servicing line.
	Leak between adapter flange and servicing line	Tighten hose clamp.
	Separator vent obstructed	Remove obstruction.
Vacuum pump vanes and bearing overheat	Faulty lubrication	Check lubricant level in vacuum pump.
Vacuum pump starts, then stops after a short running period due to overheating	Pump overheated due to lack of lubrication	Check lubricant level in vacuum pump.
	Vacuum shutoff valve closed	Open valve.
Vacuum pump fails	Belts slipping	Check belts, if badly worn, replace as outlined. Adjust belt tension.
CABINET		
Front and rear doors loose	Broken hinge	Replace hinge.
	Loose hinge hardware	Tighten attaching hardware.

hose connecting the lower cap and lower manifold. All traces of the contaminated agent should be removed and the lower cap replaced and the lower manifold hose connected. The drying agent should be quickly placed in the drier so that it does not pick up moisture from the air. Care should be given to the replacement of the indicating agent. The top cap should be screwed in place immediately after observing the condition of the indicator so that moisture or humid air does not cause the indicator to change color while the drying agent might still be active. The caps on the drier should be screwed down until they bottom. They should be removed and replaced by hand only. The O-ring packings required in the caps of the drier should not need to be replaced. However, if it is necessary to do so, remove the bolt holding down the porous filter material on the cap and replace with the proper O-rings. Replace filter material and bolt.

The manifold control valves are adjusted to be tight, but if they become loose, they can be readjusted as applied in the following steps. These valves cannot be relied upon for longtime storage.

1. Loosen locknut and open and close lever while gradually tightening lever assembly.
2. When resistance is felt, close valve and open cascade cylinder valve.
3. Check to see if pressure builds up on lower manifold. (Line valve on end of hose should be tightly closed.)
4. If valve is tight, lock in place by means of locknut. If not tight, repeat the foregoing steps.
5. Orient handle assembly by loosening locknut and rotating handle assembly and stem. Retighten locknut.

The line valve can be lubricated. When lubrication is needed, use a powdered ammonia-free graphite on the valve stem and stem head (part in contact with diaphragm). The powdered graphite may be mixed with distilled water for easier application.

TESTING OXYGEN

Aviator's breathing oxygen must be pure and it must be dry. The importance of this fact cannot be overemphasized. Lives of pilots and aircrewmen depend on it.

Impure breathing oxygen is dangerous at all altitudes. The moisture content becomes dangerous when the ambient (surrounding) temperature is low enough to freeze the droplets in an aircraft oxygen system. Therefore, aviator's breathing oxygen used in today's high-performance aircraft must be both pure and free of moisture.

Since it is so important to have pure, dry oxygen, a systematic schedule of tests must be made to insure that breathing oxygen meets the required standards outlined in the previous chapter, and that it remains that way until ready for use.

This section covers the laboratory instruments commonly used in making these inspections. For more detailed information on the operation and maintenance of these instruments, reference should be made to the applicable Operation and Service Instruction Manual. All available manuals on oxygen test equipment are listed by title and publication number in the Naval Aeronautical Publications Index under "Machinery, Tools, and Test Equipment" (17 series).

WATER VAPOR INDICATORS

Measurement of the moisture content of aviator's breathing oxygen is made with a water vapor indicator. (See figs. 5-21 and 5-22.) This instrument is suitable for measuring the moisture content of other gases such as nitrogen, CO_2, air, and helium, as well as breathing oxygen.

Aminco-Weaver Water Vapor Indicator

The water vapor indicator described in this section is manufactured by the American Instrument Company, Silver Spring, Maryland, and is identified as the Aminco-Weaver Water Vapor Indicator.

PRINCIPLES OF OPERATION.–The Aminco-Weaver Water Vapor Indicator is shown in schematic diagram form in figure 5-23. Water vapor content of the test gas is determined through comparison with the water vapor content of a standard gas, saturated under pressure, and expanded to atmospheric pressure.

Mechanically, the instrument consists of equipment to produce a standard gas of known water content and to control the pressure of the test gas.

DESCRIPTION.–The water vapor indicator consists of a main assembly shown in figure 5-22 and the accessories, shown in figure 5-21. The main assembly includes the electronic chassis and control panel, saturation and test gas pressure gages, saturator, double-tee inlet, outlet and detector blocks, and four control valves. The accessories can be stored in a cabinet which is in back of the main assembly.

The controls of the instrument and their functions follow:

MAIN SWITCH.–A two-position switch. When in the OFF position, the equipment is inoperative; when in the ON position, it connects the batteries making the equipment operative.

ADJUSTMETER.–Adjusts indicating meter to any valve whether the detector is connected or not.

VALVE A.–Adjusts the flow of gas from the test gas cylinder to the detector block.

VALVE B.–Adjusts the flow of gas from the saturator to the detector block.

VALVE C.–Adjusts the flow of test gas from the detector block to the gas outlet block.

VALVE D.–Adjusts the flow of standard gas from the detector block to the gas outlet block.

The functions of the dial instruments follow:

METER.–Indicates resistance of detector. If the meter adjustment control is not changed and resistance of the detector is constant, the meter reading remains unchanged.

SATURATION PRESSURE GAGE.–Indicates pressure in the saturator.

TEST GAS PRESSURE GAGE.–Indicates pressure in the detector block.

OPERATING PROCEDURE.–Operating procedures can be found in the Maintenance Instructions Manual.

MAINTENANCE.–Preventive maintenance would probably be a more appropriate term for the heading of this section. Preventive maintenance procedures are directed to minimizing breakdowns of equipment. This is accomplished by scheduling periodic inspections and applying the necessary corrective action before the trouble begins.

The most universal application of preventive maintenance involves a relatively simple procedure–keeping the equipment clean.

Information relative to troubleshooting, grinding the detector tip, care of the electrical system, and other maintenance problems are discussed in detail in the manufacturer's Operation and Service Instruction Manual for the Water Vapor Indicator. This manual accompanies the equipment or can be ordered through publication channels. Before operation, read the instructions. Discuss those principles which are not understood clearly with personnel who are qualified to render assistance.

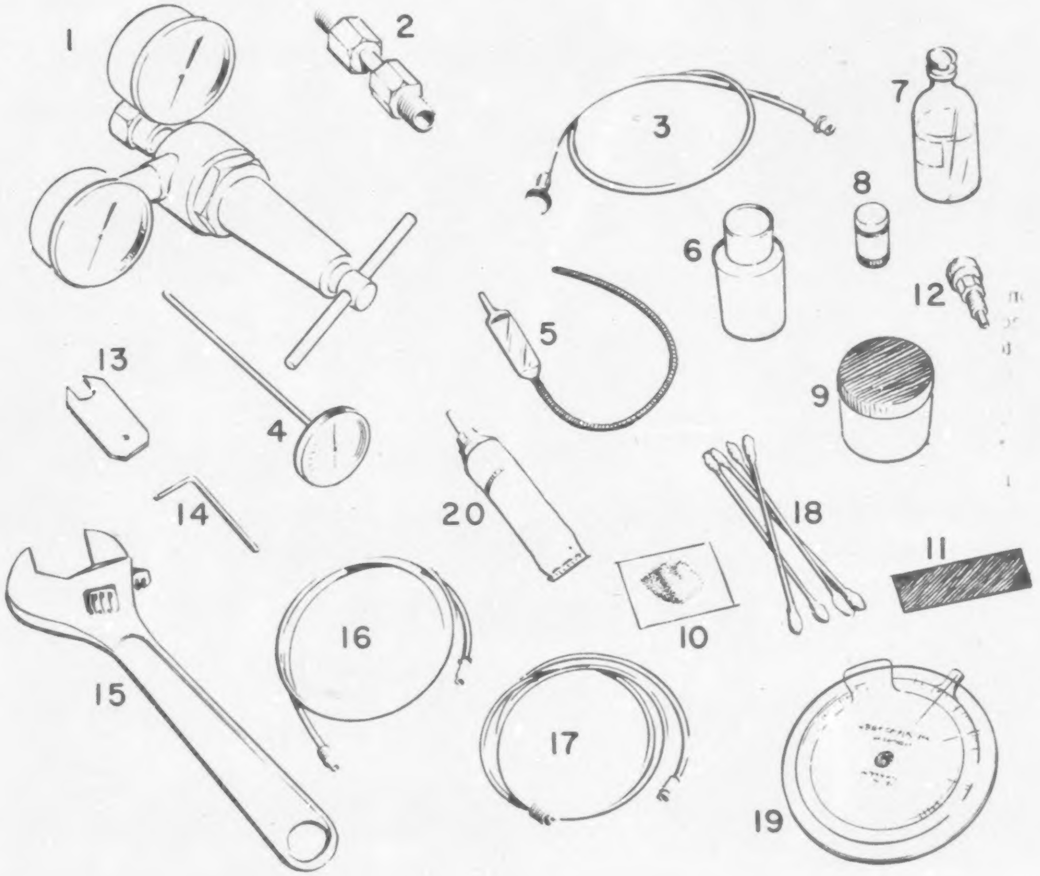
While understanding the theory of measurement (as applied to the water vapor indicator) is not absolutely necessary for the successful operation of the instrument, anyone qualified to operate and service it should make an attempt to study the principles involved.

OXYGEN ANALYZER

How can we be certain breathing oxygen, a colorless, odorless, and tasteless gas, is pure (almost 100 percent pure)? Can we trust our senses of taste and smell when the gas we breathe has a peculiar odor or leaves an undetermined taste in the mouth? Even the cleanest aircraft oxygen systems affect the odorless characteristic of the gas it conveys. Airmen breathing through a system become conscious of the odor associated with that system. This odor (a mixture and blend of odors coming from rubber, copper, aluminum, brass, etc.), when only slightly noticeable, is not cause for alarm. One reason for this is that the men breathing oxygen feel safe in doing so. They take the purity of the gas for granted. Do not misunderstand the meaning of the word purity, however. Purity can mean pure poison. When technicians in a laboratory seek the purity of a gas, they are searching for the percentage or partial pressure of a particular element in relation to others that may also be present in the given volume of gas under study.

Beckman Model E-2

This instrument is designed to provide an accurate and easily usable means of determining the partial pressure and corresponding percentage of oxygen in gaseous mixtures, or the purity of oxygen employed. To determine the partial pressure, which is a relative indication of the percentage of the gas, a comparison between a gas of known purity (reference gas) and one of unknown purity (sample or test gas) must be made. The Model E-2 was designed specifically to analyze mixtures containing a high percentage of oxygen. After proper standardization and under the recommended test specifications involving temperature, flow, pressure, and moisture content, the analyzer is accurate to within ±



AM.605

Figure 5-21.—Instrument accessories.

0.5 percent of the full scale range. (See fig. 5-24.)

PRINCIPLES OF OPERATION.—The Beckman analyzer determines the oxygen partial pressure of a gas sample in the analysis system of the instrument by measuring the magnetic susceptibility of the gas with a magnetic torsion balance. Accurate oxygen analyses can be made of mixtures containing practically any of the other gases, since oxygen is strongly paramagnetic in nature (attracted into a magnetic field). To attempt a lengthy discussion of the physical principles upon which the functioning of basic elements of the analyzer operate would exceed the purpose of a training course. In summary, by introducing gas, containing oxygen, into the instrument under a controlled rate of flow, the magnetic susceptibility present is changed by the unknown gas. Hence, the rotation of the test body assumes a new value.

The greater the percentage of oxygen in the gas (normally the AME is interested only in testing aviator's breathing oxygen for purity), the less will be the disturbance in the magnetic field. This is true because the instrument is balanced with nearly pure oxygen when it is prepared for testing. Furthermore, by setting a

Nomenclature for figure 5-21.

1. Press regulator–used to regulate pressure in saturator.
2. Oxygen valve adapter–used to adapt oxygen valve outlet nut to standard 3/8-inch diameter nut.
3. Cable–used to connect detector to electrical indicator.
4. Thermometer–used to measure ambient temperature around equipment.
5. Pipette–used for adding water to saturator. (With care, a hypodermic syringe fitted with a long needle can also be used.)
6. Phosphoric anhydride–forms phosphoric acid (alternate electrolyte) when exposed to water. The resulting acid is a sirupy hygroscopic liquid and is placed on the detector when moderately dry gases are being measured for water content.
7. Electrolyte–this liquid is made up of 3 parts phosphoric acid and 1 part sulphuric acid; it serves as hydroscopic material when placed on tip of the detector (varies in resistance with water vapor content of gas surrounding it). Used when very dry gases are being measured for water contents. (Aviator's breathing oxygen is supposed to be very dry for reasons already familiar to AME's.)
8. Vial–used to protect expensive and delicate detector.
9. Jar–used to hold aloxite grinding compound.
10. Grinding compound–aloxite fine grinding compound grit No. 95, used to grind tip of detector.
11. Grinding plate–used to hold grinding compound while grinding detector tip (any microscope glass slide may be used).
12. Detector–used to detect water vapor, and must be handled with care.
13. Wrench–W-1–used to tighten nuts of flow assembly and tighten detector in block.
14. Wrench–W-2–used to remove valves, detector block, gas outlet and inlet block, double tee, and saturator from base.
15. Wrench–W-3–used to tighten pressure regulator to cylinder of supply gas for saturator, to tighten oxygen valve adapter to test gas cyliner, and to tighten gland nuts of valves A, B, C, and D.
16. Pressure reducer-saturator line–used to connect pressure regulator to saturator.
17. Cylinder-inlet-block line–used to connect oxygen cylinder to inlet block.
18. Applicators–cotton tipped wooden sticks, used to apply and remove excess electrolyte from detector.
19. Moisture calculator–used to calculate moisture content of test gas.
20. Grease–Dow Corning 33 grease of medium consistency used to grease threads and tips of valves A, B, C, and D whenever instrument has been disassembled for baking out or cleaning.

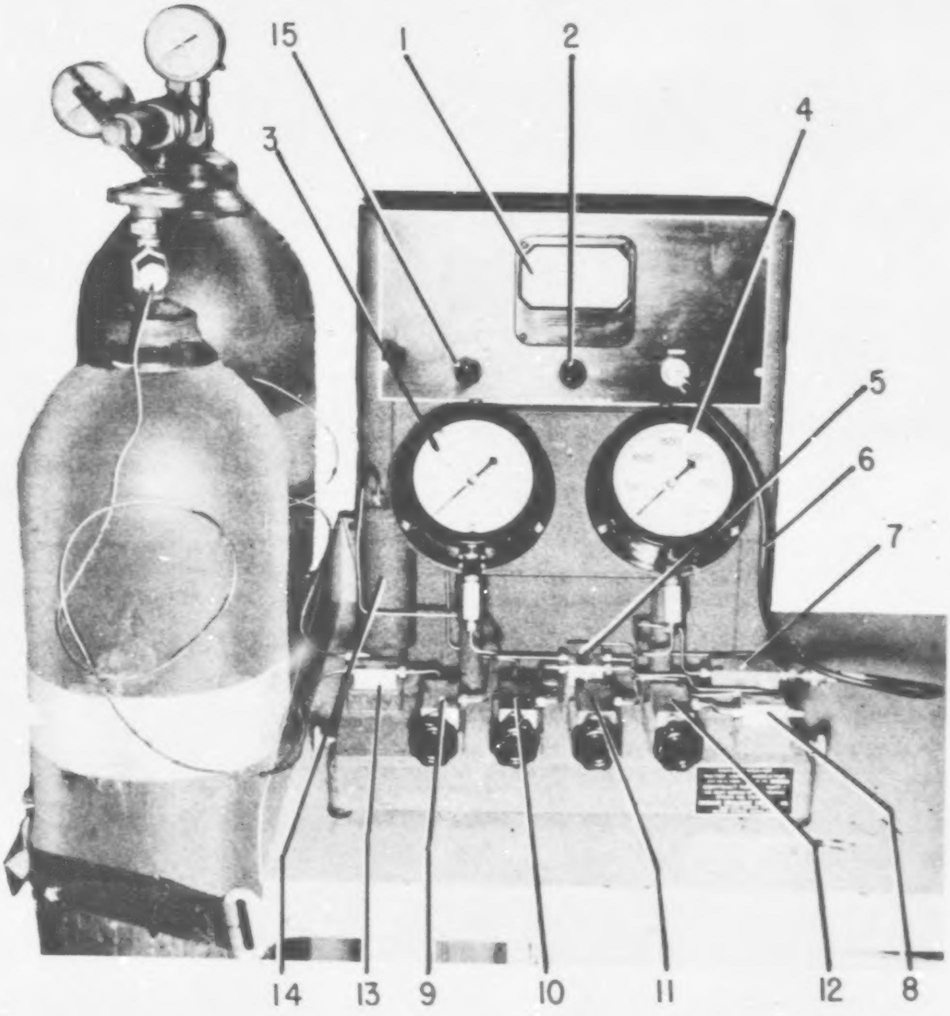
dial to read this imbalance, the comparative purity of the gas can be determined in a percentage value.

Operation.–The operating procedures can be found in the Maintenance Instructions Manual and should be followed when the instrument is used. Figure 5-25 is a diagrammatic view of the gas sampling system.

MAINTENANCE.–Thorough inspections are conducted at specified intervals to determine the condition and serviceability of the analyzer. Preventive maintenance procedures including cleaning, tightening, calibration, and testing are performed at the specified intervals of calendar or operating times. A permanent record of inspections, calibrations and overhaul of the instrument should be kept. Naturally, only qualified personnel should conduct the procedures.

Inspections and maintenance required daily are those to be performed prior to use of the analyzer during any day of operation. Inspection times indicated in hours are the approximate instrument operating times between inspections. These times are expected to vary with operations.

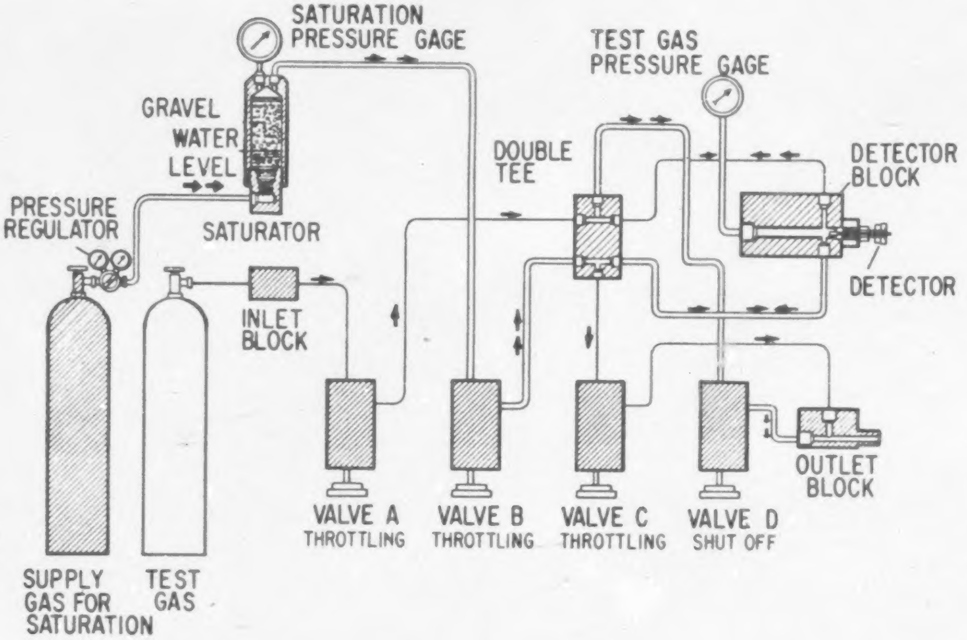
Cleans the lens and windows of the optical system with lens tissue; moisten with water if necessary. Clean the parts of the analyzer chassis



AM.604

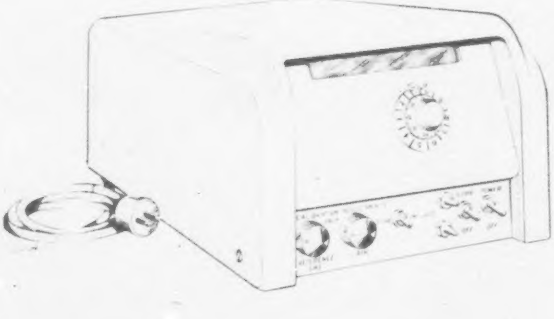
1. Microammeter.
2. Adjustmeter.
3. Saturation pressure gage.
4. Test gas gage.
5. Double tee.
6. Cable.
7. Detector block.
8. Outlet block.
9. Valve A.
10. Valve B.
11. Valve C.
12. Valve D.
13. Inlet block.
14. Saturator.
15. Main switch.

Figure 5-22.—Front view of water vapor indicator—cover removed.


SATURATION
PRESSURE GAGE
TEST GAS
PRESSURE GAGE
GRAVEL
WATER
LEVEL
DOUBLE
TEE
DETECTOR
BLOCK
PRESSURE
REGULATOR
SATURATOR
DETECTOR
INLET
BLOCK
VALVE A
THROTTLING
VALVE B
THROTTLING
VALVE C
THROTTLING
VALVE D
SHUT OFF
OUTLET
BLOCK
SUPPLY
GAS FOR
SATURATION
TEST
GAS

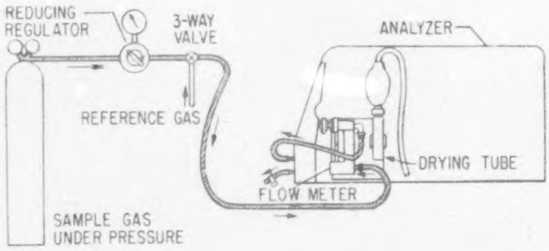
AM.603

Figure 5-23.–Schematic diagram of the water vapor indicator.



AM.610

Figure 5-24.–Beckman Model E-2.


REDUCING
REGULATOR
3-WAY
VALVE
ANALYZER
REFERENCE GAS
DRYING TUBE
FLOW METER
SAMPLE GAS
UNDER PRESSURE

AM.611

Figure 5-25.–Gas sampling system.

with an approved cleaning solvent. Use the solvent sparingly and apply with a clean lint-free cloth or soft brush. Dry parts thoroughly. To remove dust from inaccessible places, use dry compressed air at a maximum of 30 psi pressure. There are no lubrication problems.

General inspection and maintenance procedures are outlined in table 5-9.

Information relative to balancing portions of the analyzer circuits, barometric and moisture corrections, mathematical formulas involving the use of the duodial, troubleshooting, and other subjects can be found in Operation and Service Instruction Manual for the Oxygen Analyzer.

HALIDE DETECTION

While knowledge of the percentage of oxygen in a volume of gas is a good indication of its purity, it is not entirely reliable. Oxygen itself can never be anything else but oxygen, and as such it is pure; however, it can become contaminated. Unfortunately, this contamination is not detectable through the use of the oxygen analyzer. Since this is true, some device other than the analyzer which indicates the percentage of oxygen in a gaseous mixture must be used to detect the presence of halides.

A halide is a binary compound containing a halogen (chlorine, bromine, iodine, or fluorine). Binary means that chemically it is composed of two elements, of an element and a radical that acts as an element, or of two radicals. The halide of primary interest to the AME is a chloride.

Contamination takes place when oxygen comes in contact with chlorinated hydrocarbons. The practice of using carbon tetrachloride to clean parts of a system will later contaminate oxygen gas passing through it. The fact that carbon tetrachloride dries very rapidly and seemingly vanishes from the scene is not to be trusted. The fluid residue and gas fumes created in cleaning permeate the surfaces of components; therefore, it is an ineffectual gesture to attempt wiping it away with a cloth. One must be extremely careful not to use anything but approved solvents or cleaning agents around oxygen equipment. The contamination of oxygen is dangerous—from its explosive supporting nature to its purity requirements for human consumption.

Table 5-9.—Inspection and maintenance procedures.

Procedure	Time
Check operation of analyzer lamp	Daily.
Check operation of pilot light	Daily.
Check movement of duodial and calibration setting knobs	Daily.
Clean exterior of front panel window	Daily.
Check condition of drying agent in drying tube; replace if pink	Daily.
Check operation of switches	Daily.
Clean lens and windows of optical system with lens tissue	Weekly.
Clean interior of analyzer	Monthly.
Check all wiring connections at terminal strips for tightness of terminal screws	Monthly.
Inspect soldered wire connections for looseness	Monthly.
Check tightness of all attaching screws, bolts, etc.	Monthly.
Inspect condition of rubber shock mounts	Monthly.
Inspect all parts of analyzer for evidence of corrosion	Monthly.
Check tightness of all tubes in sockets	Monthly.
Remove, test, and replace as required, all tubes in rectifier assembly	100 hours.
Insert test thermometer through hole in right rear corner of insulated suspension unit housing to check temperature of suspension housing	100 hours.
Check transformer for excessive heating	100 hours.
Remove insulated suspension unit housing and check security of wire connections and sample inlet tubes	200 hours.

Chlorinated Hydrocarbon Contamination

Aviator's breathing oxygen storage cylinders, regardless of source, and aircraft oxygen cylinders are tested for chlorinated hydrocarbon contamination prior to their release for breathing purposes in aircraft. After a satisfactory completion of the test, a distinguishing tag or decal is applied to each cylinder tested, giving the date of the test, place, name of the individual conducting it, and a statement that the cylinder tested does not contain any chlorinated hydrocarbons as evidenced by no change in the color of the testing flame.

This test is performed with a halide detector, one type of which is illustrated in figure 5-26. Another type, designed to burn methyl alcohol and resembling the appearance of a flashlight, may also be used.

The normal uncontaminated flame color of the halide detector which uses methyl alcohol is colorless or possibly a very faint blue. The presence of a very slight trace of chlorinated hydrocarbon impurities in the oxygen causes

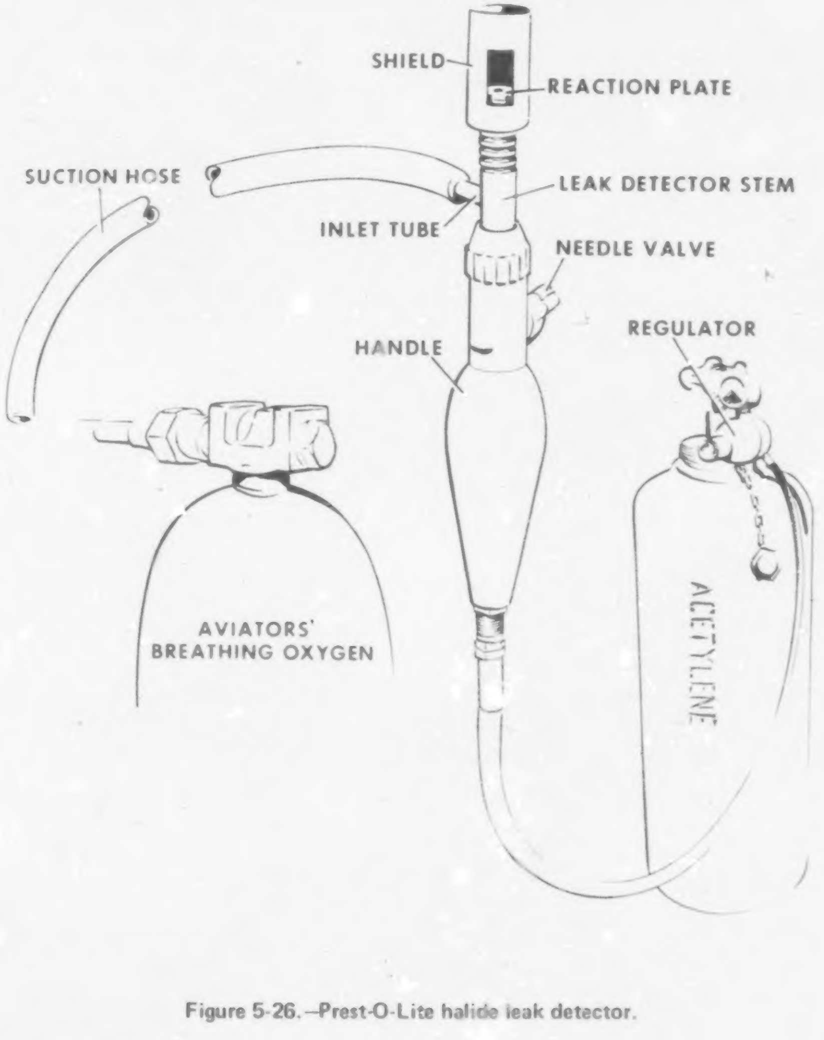

SHIELD
REACTION PLATE
SUCTION HOSE
LEAK DETECTOR STEM
INLET TUBE
NEEDLE VALVE
REGULATOR
HANDLE
AVIATORS' BREATHING OXYGEN
ACETYLENE
AM.612

Figure 5-26.–Prest-O-Lite halide leak detector.

this flame color to become pale green, and as the proportion of impurities increases in the oxygen a bluish-green colored flame results.

The normal uncontaminated flame color of the halide detector which uses acetylene is blue. The presence of a very slight trace of chlorinated hydrocarbon impurities in the oxygen causes the color of the flame to become pale green; and as the proportion of impurities increases, the flame becomes a more intense green. A large proportion of such impurities in the oxygen results in an intense violet color.

Any chlorinated hydrocarbon contamination, as evidenced by the color of the flame of the halide detectors, is cause for rejection of oxygen cylinders containing this contaminated oxygen. CONTAMINATED OXYGEN MUST NOT BE USED. Rejected cylinders are appropriately tagged and returned to supply through normal channels for overhaul prior to their being recharged and retested, submitting a report to NavAirSysCom regarding circumstances of test.

CHAPTER 6

OXYGEN SYSTEM MAINTENANCE

Personnel of the AME rating are responsible for servicing and maintaining aircraft oxygen systems, both the gaseous type and the liquid type. Prior to commencing study of this chapter, it will be well to review the chapters on oxygen in Aviation Structural Mechanic E 3 & 2, NavPers 10309 (Series). Since qualifications for advancement to a higher rating necessarily include qualifications of the lower rate or rates in addition to those stated for the higher rate, repetitious material in this chapter is held to a minimum consistent with full coverage of advanced AME qualifications.

AIRCRAFT GASEOUS OXYGEN SYSTEMS

Servicing of gaseous oxygen systems consists of recharging the system, usually from a portable servicing trailer. General maintenance includes performing routine periodic inspections, testing, repairing leaks, and removing and replacing components, lines, and fittings, as necessary. Regulators are removed and installed by the AME, but are shop tested, checked, and repaired by personnel of the PR rating.

Most of the AME functions mentioned in the previous paragraph are second and third class "quals." In most cases they will be accomplished under the supervision of an AME1 or AMEC whose responsibility it is to analyze system malfunctions, isolate defective components, and determine corrective action.

NOTE: Safety precautions pertaining to oxygen are covered at various points throughout this chapter. A section on organization and administration of safety programs is included in chapter 2.

OPERATION OF GASEOUS OXYGEN SYSTEM

Various gaseous oxygen system installations are illustrated and explained in Aviation Structural Mechanic E 3 & 2, NavPers 10309 (Series). In general, the oxygen is supplied from one or more oxygen cylinders located about the aircraft. When more than one cylinder is used, they usually feed into the supply lines through check valves that are provided to prevent loss of all oxygen in the event of rupture of some of the lines and cylinders. All cylinders are usually filled through a common external filler. Here again a check valve arrangement prevents loss of oxygen in the event of filler line rupture.

Since the oxygen is compressed in the cylinders, the amount of pressure indicated on the oxygen system gages bears a direct relationship to the amount of oxygen contained in the cylinders. The quantity-indicating pressure line connection is located between the cylinders and a pressure reducing valve. NOTE: In a few types of gaseous oxygen systems, no pressure reducers are used. In these systems, the high pressure is reduced by the regulator to a safe, usable pressure and the cylinder pressure-indicating gage is located on the regulator.

Regulators are provided at every oxygen-using station to control the oxygen flow to the user during high-altitude flight. Most regulators automatically mix varying quantities of air and oxygen, the ratio depending upon the altitude, and deliver the quantity demanded upon inhalation by the user. In emergencies it is possible to select 100 percent oxygen.

MAINTENANCE

Routine maintenance consists of servicing the storage cylinders, testing the system for leaks, and checking the operation of the regulator.

Certain malfunctions may be discovered during testing as well as during actual use of the oxygen system. The remedies for some of the malfunctions may be obvious; others may require extensive time and effort to pinpoint. In any event, the effectiveness of corrective action depends upon an accurate diagnosis of the malfunction.

Each aircraft manufacturer is required to furnish diagrams of the various systems found in the aircraft, in addition to the cross-sectional views of system components that will aid in the understanding of their operation. These schematic or installation diagrams are defined as graphic representations of an assembly or system indicating the various parts and expressing the methods or principles of operation.

Troubleshooting

In order to troubleshoot intelligently, the AME must be familiar with the system. He must know the function of each component and have a mental picture of the location of each in relation to other components as well as their location in the aircraft. The best way to achieve this knowledge is by studying the diagrams of the system provided in the applicable Maintenance Instructions Manual. In addition to installation and schematic diagrams in the aircraft Maintenance Instructions Manual, the AME will be furnished troubleshooting charts to aid in discovering the probable causes of malfunctions in the system and the possible remedies for their correction.

Table 6-1 illustrates one type of chart used by aircraft manufacturers. The discrepancy is listed in the left-hand column with the probable cause in the second column. The most probable cause is listed first, the next most probable cause second, etc. The remedy or correction of the discrepancy is in the third column adjacent to the cause of the discrepancy.

Other manufacturers furnish charts similar to the one illustrated in table 6-2. This type of chart gives a step-by-step method to correct known malfunctions. Notice how each step progresses through the system. At each step it indicates a correction procedure; however, if the system is functioning properly at this point, directions are given to proceed with the troubleshooting procedure.

USE OF DIAGRAMS.—Each aircraft manufacturer is required to furnish schematic diagrams of the oxygen system. These diagrams will be found in the aircraft Maintenance Instructions Manual. By learning to interpret these diagrams, the AME can save time while trying to isolate malfunctioning components.

Schematic diagrams do not indicate the location of components in the aircraft, but they do indicate their location in relation to other components in the system. The primary purpose of schematic diagrams is to enable the AME to trace the oxygen flow, component by component, from the storage bottle to the oxygen mask. The more familiar the AME is with the schematic diagram of the system, the easier he will find it to locate the malfunctioning component within the oxygen system.

TROUBLESHOOTING PROCEDURES.—Troubleshooting procedures are similar in practically all applications. These procedures are certainly adaptable to aircraft oxygen systems as well as their components. Auto mechanics use these same steps to find and repair malfunctions in automobiles. The AME uses these procedures to find and repair malfunctions within aircraft oxygen systems.

Basically, there are seven distinct steps to follow during troubleshooting. These steps are as follows:

1. Conduct a Visual Inspection. This inspection should be thorough and searching—checking all lines, units, and components for evidence of leaks, looseness, security, material condition, and proper installation. During this visual inspection, the oxygen system is checked for proper servicing.

2. Conduct an Operational Check. The malfunctioning system is checked for proper operation. This is accomplished by observing the system's regulators and pressure indicators while the system is in operation; the AME also performs a system leakage check during this step.

3. Classify the Trouble. Malfunctions normally fall into three basic categories—leakage, contamination, and mechanical. Using the acquired information from both steps 1 and 2,

Table 6-1.–Gaseous oxygen system troubleshooting.

Discrepancy	Probable cause	Remedy
Excessive leakage of system pressure.	Filler valve leaking.	Replace filler valve.
	Leak in lines.	Check tubing, fittings, and connections and repair or replace as necessary.
	Flexible hose leaking.	Replace hose.
	Regulator not shut off.	Shut off regulator.
Crewmember receives insufficient oxygen at high altitude.	Improperly functioning regulator.	Replace regulator.
	Ill-fitting mask.	Refit or replace mask.
	Mask flapper valve not operating properly.	Check mask exhaust valve.
	Flexible tubing to mask crushed or kinked.	Replace tubing as necessary.
No pressure reading at the regulator.	Defective regulator.	Replace regulator.
	Oxygen supply turned off.	Turn on cylinder hand valve if so equipped.
	System not charged.	Replenish oxygen supply.
Regulator pressure gage indications are incorrect.	Gage defective.	Replace gage.
Regulator flow indicator not functioning.	Indicator defective.	Replace regulator.

the AME determines under which classification the malfunction occurs.

Something affecting normal flow of oxygen is generally classified as either contamination or mechanical, or both.

CONTAMINATION within the oxygen system may obstruct lines, orifices, or passageways–causing partial or complete restriction of the oxygen flow. Moisture within a system, freezing at high altitude, will cause insufficient or complete restriction of oxygen.

MECHANICAL malfunctions can usually be located during visual inspections–improper installation of components, lines, etc. However, some mechanical malfunctions can only be discovered during the operational check by denoting the response of the system's equipment. If it is determined that the deficiency of oxygen is not caused by external leakage, it would be well to check the system check valves to see if they are installed correctly and are working properly. A reversed check valve in a filler line will prevent a cylinder from filling during the servicing operation. A handy and reliable check for this is to feel the cylinders after servicing–all should be warm. If one or more are still cold and some are warm, it indicates that the cold cylinders were not filled. Of course, if the cylinders have manual shutoff valves, these should be checked first to insure

Table 6-2.—Gaseous oxygen system troubleshooting chart.

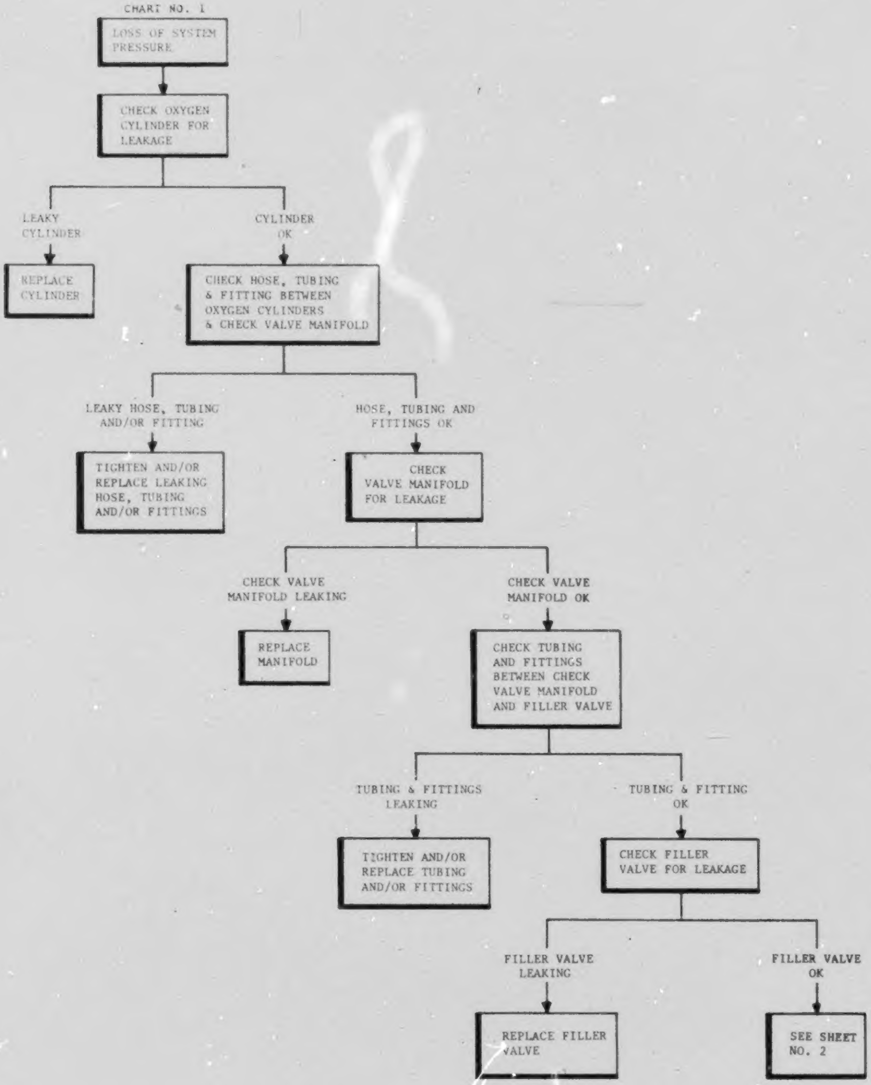


CHART NO. 1
LOSS OF SYSTEM PRESSURE
CHECK OXYGEN CYLINDER FOR LEAKAGE
LEAKY CYLINDER
CYLINDER OK
REPLACE CYLINDER
CHECK HOSE, TUBING & FITTING BETWEEN OXYGEN CYLINDERS & CHECK VALVE MANIFOLD
LEAKY HOSE, TUBING AND/OR FITTING
HOSE, TUBING AND FITTINGS OK
TIGHTEN AND/OR REPLACE LEAKING HOSE, TUBING AND/OR FITTINGS
CHECK VALVE MANIFOLD FOR LEAKAGE
CHECK VALVE MANIFOLD LEAKING
CHECK VALVE MANIFOLD OK
REPLACE MANIFOLD
CHECK TUBING AND FITTINGS BETWEEN CHECK VALVE MANIFOLD AND FILLER VALVE
TUBING & FITTINGS LEAKING
TUBING & FITTING OK
TIGHTEN AND/OR REPLACE TUBING AND/OR FITTINGS
CHECK FILLER VALVE FOR LEAKAGE
FILLER VALVE LEAKING
FILLER VALVE OK
REPLACE FILLER VALVE
SEE SHEET NO. 2

they were open. Each check valve has an arrow on the valve body indicating the direction of flow. If one is reversed, a quick visual inspection may readily result in locating the discrepant installation.

If it is determined that all cylinders are fully serviced and that all check valves in the filler lines are correctly installed, the next check should be made for correct installation and proper operation of check valves in the distribution system lines. This may be determined by causing an excessive flow of oxygen through the regulator. A cylinder which is not cooling as gas is escaping indicates a blocked line—most likely due to a reversed check valve.

LEAKAGE malfunctions are found by applying the standard leakage test procedures discussed later in this chapter. The test conducted usually amounts to observing the system's pressure over a specified period of time. A loss of pressure, allowing for temperature change, is an indication of a loss of volume.

If it is determined that oxygen is being lost from a system through leakage, an orderly sequence of steps is necessary to pinpoint the opening. Gross leakage may be readily detected by listening for the distinct hissing sound of escaping gas. Should this test prove negative, it will be necessary to soap-test all connections with a castile soap and water solution or a specially compounded leak-test material. (A suitable soap is available in the supply system under Specification MIL-S-4282A. The special leak-test compound is available as MIL-L-25567A.) The solution should be thick enough to adhere to the contours of the fittings. Some bubbles will be formed during the application of the solution. Observe all bubbles carefully, pushing them aside from time to time to see if new ones will form. Bubble formation indicates leakage. At the completion of the leakage test, all traces of the soap and water should be carefully removed, leaving the fittings clean and dry.

4. Isolate the Trouble. This step calls for sound reasoning and a full and complete knowledge of the behavior of oxygen under conditions found in aircraft oxygen systems, as well as a complete understanding of the oxygen system. During this step, the AME uses his knowledge and known facts, formulated by the preceding steps, to determine where the malfunction exists in the system. Usually the trouble can be pinned down to one or two areas. This is done by eliminating those units that can be proved to be operating normally.

5. Locate the Trouble. This step is used to eliminate unnecessary part removal, thus saving money and manhours. By determining what unit or units in the system could cause the malfunction, the AME verifies his isolation step.

Both contamination and mechanical malfunctions are verified in a similar manner. The AME removes lines and inspects them for correct flow into or out of the suspected component. Incorrect flow from a component indicates a malfunctioning component which should be replaced.

Mechanical malfunctions are located by closely observing the suspected unit to see if it is operating in accordance with the applicable aircraft Maintenance Instructions Manual. Mechanical discrepancies are usually located during the visual inspection in step 1.

6. Correct the Trouble. This step is accomplished only after the trouble has been definitely located and there is no doubt that the AME's diagnoses are correct. Malfunctions are usually corrected by replacement of components, retorquing of line fittings, and servicing the system.

NOTE: Check the applicable Maintenance Instructions Manual for CAUTION, WARNING, AND SAFETY notes concerning maintenance procedures.

7. Conduct a Quality Assurance Check. The affected system must be operated sufficiently until a thorough check has been made to determine that its operation is satisfactory.

If troubleshooting time is considered significant, a separate single copy Maintenance Action Form showing a common job control number and action taken code "Y" should be utilized to provide input data that accounts for the troubleshooting time and actual repair time separately.

Leakage Testing

The pressure gage is the only instrument available to indicate the amount of oxygen in the system, although it is not primarily a quantity-indicating instrument. In any system a high pressure will indicate that there is more oxygen in the system than would be there if the pressure reading was low. A loss of a given volume of oxygen from a small cylinder will result in a larger pressure drop in that cylinder than the loss of the same volume from a larger cylinder. The same principle applies when several cylinders all the same size are connected to a common system. Therefore, a leakage of 50 psi registered on a common gage for two 514-cubic inch cylinders is, volumetrically, twice as great as it would be for one cylinder. Thus, it is necessary to divide the number of cylinders installed into the amount of allowable leakage for one cylinder times the number of flight stations provided with oxygen to arrive at the allowable leakage pressure drop for the entire system.

The permissible pressure drop can be determined for any aircraft oxygen system incorporating high-pressure cylinders (1,800 psi) by applying the following:

$$P = \frac{50 \times N_1}{N_2} \text{ or } P = \frac{90 \times N_1}{N_2}$$

where

P = the permissible 24-hour pressure drop in psi.

N_1 = the number of flight stations provided with oxygen.

N_2 = the number of high-pressure cylinders.

50 psi – allowable leakage for one 514-cubic inch cylinder using one regulator for a 24-hour period.

90 psi – allowable leakage for one 295-cubic inch cylinder using one regulator for a 24-hour period.

TESTING PROCEDURE.–A typical test for system leakage, using 514-cubic inch capacity cylinders with one flight station, follows:

For purposes of illustration of this test it will be assumed that the temperature at the time of filling the system is 70°F. To attain 1,800 psi under this temperature condition, the filling pressure would have to be 1,925 psi due to thermal expansion during filling. After a relatively short cooling-off period, the cylinder pressure would level off at 1,800 psi, provided the temperature of 70°F did not change. After 24 hours, take another pressure reading and, if necessary, adjust for temperature change. The pressure will vary 3 ½ pounds in direct proportion to each degree (Fahrenheit) of temperature change. If, for example, at the end of the 24-hour period the temperature had dropped to 40°F and the pressure reading was 1,685 psi, the temperature adjustment would show that 105 psi of the apparent loss was due merely to thermal contraction. The actual loss through leakage was 10 psi which is well within the limit of 25 psi (derived from the leakage formula in the previous paragraph.)

Installation Inspection

All oxygen tubing and equipment throughout the system should be inspected to insure that at least a 2-inch clearance exists between oxygen system components and control cables or other moving parts of aircraft. It may be necessary to bend or reroute oxygen tubing to maintain this clearance; however, the tubing must be mounted so that vibration and chafing will not occur. Discrepancies of this nature can be rectified by use of additional clips or flexible grommets.

Clearance between oxygen tubing and electrical wires must also be maintained throughout the system. It is desirable to maintain a 6-inch clearance between oxygen tubing and electrical wires. In cases where this is not possible, the electrical wires should be clamped so that they cannot come closer than 2 inches to the oxygen tubing. There may be some instances where it is not possible to maintain even the 2-inch clearance. In such cases, current directives require that the electrical wires be covered with an electrical insulating material and clamped so that the wires cannot come closer than one-half inch to oxygen tubing. Electrical wires must not come closer than one-half inch to oxygen tubing except for mask-to-regulator tubing.

Where barriers such as frame, ribs, or permanent partitions exist between oxygen tubing and wiring or moving parts, and where electrical wiring is leading into oxygen equipment or a component thereof, the requirements for separation and covering do not apply. A minimum of ½-inch must be maintained between oxygen tubing and rigid controls such as rods and bellcranks.

REGULATORS

Automatic Positive Pressure Diluter Demand Oxygen Regulator

The following descriptive data for the use, operation, test, and troubleshooting of the automatic positive pressure diluter demand oxygen regulator is applicable to the type 2867-B2. The Operation, Maintenance and Overhaul Instructions Manual for Automatic Positive Pressure Diluter Demand Oxygen Regulators and Diluter Demand Oxygen Regulators, NavAir

03-50A-48, provides difference data on 4 regulators.

The automatic positive pressure diluter demand oxygen regulator is designed for use by aircraft crewmembers in high-altitude flight. The regulator is installed in the oxygen system between the oxygen supply and the crewmember's mask. Oxygen at pressure ranging from 50 to 2,000 psi is admitted to the regulator through the inlet assembly. This oxygen passes through a reducer assembly that drops the pressure to a valve between 40 and 60 psi when there is a flow through the regulator, making the regulator operation substantially independent of the inlet pressure. Air is admitted to the regulator through the air valve on the panel of the regulator. The air-oxygen mixture is delivered to the mask by means of a flexible hose attached to the outlet of the regulator. The regulator is used with a type A-13A pressure breathing mask.

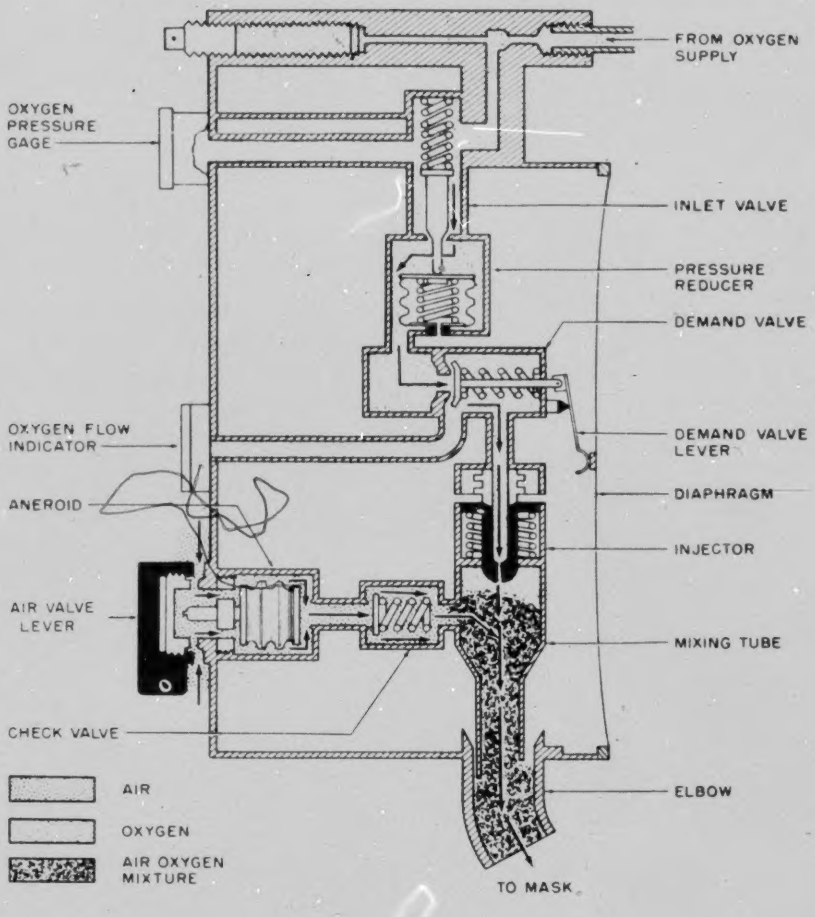
OPERATION.–Normal breathing depends upon the pressure of the oxygen in the air. The pressure of the oxygen in the air, at any altitude, is 21 percent of the ambient atmospheric pressure. The higher the aircraft ascends, the lower will be the oxygen pressure in the air cells of the mask wearer's lungs. At sea level, atmospheric pressure is approximately 14.7 psi. This pressure and, therefore, the oxygen pressure is reduced to approximately one-half the sea level pressure at 18,000 feet; to approximately one-fourth sea level pressure at 34,000 feet; and to about one-eighth sea level pressure at 48,000 feet. In high-altitude flight, the oxygen regulator simulates the oxygen pressure conditions existing at sea level. The oxygen regulator performs this through the medium of an aneroid assembly which progressively delivers richer oxygen-air mixtures as the altitude is increased.

When flight conditions require the use of diluted oxygen, the air valve must be set at NORMAL OXYGEN. (See fig. 6-1.) Oxygen from the supply enters the regulator through the inlet and shutoff valve assembly. It flows from the oxygen inlet orifice through the inlet valve and into the pressure reducer chamber. The expansion and contraction of the pressure reducer bellows controls the inlet valve and reduces the supply pressure to an operating pressure between 54 and 56 psi. The operating pressure depends on the pressure reducer adjustment. When the pressure in the chamber reaches its maximum, the bellows contracts, permitting the inlet valve against the seat, shutting off the oxygen flow.

Oxygen flows from the pressure reducer chamber into the upper half of the demand valve chamber. The demand valve is controlled by the diaphragm which, in turn, is controlled by inhalation/exhalation of the person using the regulator. The tip of the demand valve lever presses against the center of the diaphragm. When the mask wearer inhales, the diaphragm is depressed, pivoting the demand valve lever, the opposite end of which is pinned to the demand valve stem. When the diaphragm moves, the demand valve stem rises from its seat, permitting oxygen to enter the lower half of the demand valve chamber. The oxygen then passes through the hole in the upper part of the chamber into the injector assembly. When the mask wearer exhales, the diaphragm rises, pivoting the demand valve lever in the opposite direction, and closing the demand valve.

When the air valve lever is turned counterclockwise, the air valve cover is raised above the air valve body, and the air flows under the cover, through two inlet holes in the body, and down through the air valve screen into the aneroid and check valve assembly. At sea level, the aneroid bellows is contracted, allowing air to pass through the base of the aneroid assembly. However, when the suction buildup is sufficient to overcome pressure of the check valve disc on the aneroid and check valve assembly seat, air continues into the air chamber. At higher altitudes the aneroid expands, gradually forcing the throttling plate against the air valve seat, and eventually shutting off all airflow into the chamber. Air admitted to the air chamber flows into the mixing tube. The check valve assembly closes when the mask wearer exhales, preventing the escape of oxygen. It also prevents any airflow until a definite suction is built up to the point where the air-oxygen mixture will not be too lean at small flows.

Oxygen from the demand valve flows into the injector assembly. As it leaves the injector nozzle, air from the air valve mixes with it. Upon inhalation, the mixture of air and oxygen is drawn through the mixture tube and delivered


FROM OXYGEN SUPPLY
OXYGEN PRESSURE GAGE
INLET VALVE
PRESSURE REDUCER
DEMAND VALVE
DEMAND VALVE LEVER
OXYGEN FLOW INDICATOR
DIAPHRAGM
ANEROID
INJECTOR
AIR VALVE LEVER
MIXING TUBE
CHECK VALVE
ELBOW
AIR
OXYGEN
AIR OXYGEN MIXTURE
TO MASK

AM.580

Figure 6-1.—2687-B2 regulator schematic (normal oxygen flow).

through the outlet to the oxygen mask. The injector assembly is capable of handling large flows, if such are required. The injector sleeve forms a valve with the injector nozzle. For high flows, the nozzle unseats itself, and releases a greater quantity of oxygen through holes in the lower part of the injector sleeve.

Should there be need for pure oxygen before the aneroid automatically closes the air channel, the channel may be closed by manually positioning the air valve to 100% OXYGEN. With the air valve set at 100% OXYGEN, undiluted oxygen will flow.

The automatic positive pressure diluter demand oxygen regulator contains a manually operated safety pressure mechanism. When the SAFETY PRESSURE knob is rotated to the ON position, a spring-loaded lever depresses the diaphragm hub, which opens the demand valve, causing the internal pressure of the regulator to increase slightly above the external pressure. Thus, when the mask wearer inhales, a negative pressure is set up in the mask (between 1-½ and 2 inches of water). As long as the internal positive pressure of the regulator is adequate, the demand valve will remain closed even though the SAFETY PRESSURE knob is in the ON position.

The automatic positive pressure mechanism in the regulator incorporates an aneroid mechanism in the back of the regulator. (See fig. 6-2.) As atmospheric pressure decreases with altitude, the aneroid expands and, through mechanical linkage to the diaphragm, allows the outlet regulator pressure to rise at altitudes above 35,000 feet.

OPERATIONAL TESTING.—Prior to each flight the regulator should be checked for proper operation. This is accomplished by first making sure that the system is fully charged to the prescribed pressure. The air valve is then placed in the NORMAL OXYGEN position and the SAFETY PRESSURE knob turned to ON. Check to see that oxygen flows from the accordion tubing and that the blinker moves up and down and remains in the open position.

Block off the accordion tubing with the thumb or palm of the hand for a period of 30 seconds. The flow indicator should move immediately to the closed position and remain in that position. If the flow indicator does not remain in the closed position for this test, oxygen is still flowing and excessive leaks are present. These leaks may be through the case, through the demand diaphragm, through outlet tubing connections, or they may be due to inlet or demand valve leakage, which would cause the internal pressure in the regulator to rise and the blinker to open.

TROUBLESHOOTING.—Should the regulator fail to deliver oxygen, the probable cause is a clogged connection line or a faulty demand valve stem. A clogged line might be remedied by disconnecting the regulator and blowing oxygen from the cylinder through the connecting tubing to remove the obstruction. If the trouble is a malfunctioning demand valve stem, the regulator should be removed and turned in to the regulator shop for repair or processing back to the overhaul activity.

MD-1 and MD-2 Oxygen Regulators

The MD-1 oxygen regulator is being used in several new multiplace naval aircraft. This regulator is designed for use in low-pressure systems (gaseous systems which utilize a pressure reducer or liquid oxygen systems). The MD-2 is used in high-pressure systems. The MD-1 is described in the following paragraphs.

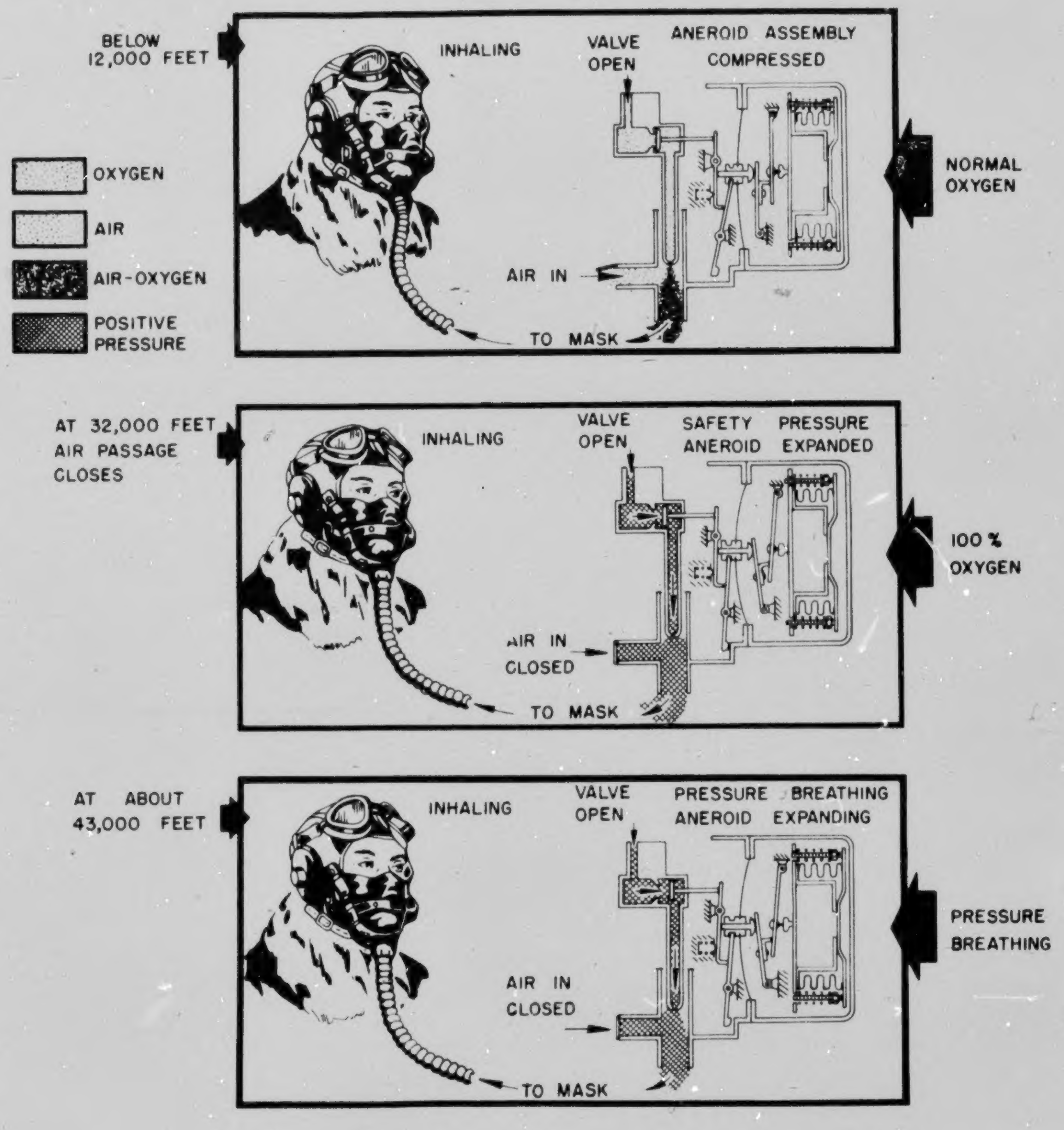
The MD-1 regulator is designed for use with the pressure type mask to provide the correct oxygen and air mixture in the proper ratio (depending upon the altitude) and deliver this mixture at the correct oxygen pressure to the mask upon inhalation. With a tight mask and the diluter control lever in the NORMAL OXYGEN position, the regulator provides correct breathing mixtures at altitudes up to 43,000 feet for normal use and for short periods up to 50,000 feet during emergencies. The operating pressure ranges from 50 to 500 psi. The MD-2 is identical in every respect to the MD-1 except for the operating pressure, which ranges from 50 to 2,000 psi.

OPERATION.—All controls and indicators necessary for indication of performance and control of operation of the MD-1 regulator are placed on an illuminated panel with the regulating components of the unit attached to the mounting plate and controls assembly. General characteristics and performance for which the equipment is designed are illustrated in figure 6-3 and are described as follows:

Supply oxygen entering through the inlet from the oxygen supply is filtered and passes through the manifold inlet assembly into the first stage pressure reducer chamber by the action of inlet supply valve. The pressure of the oxygen is registered on the oxygen supply pressure gage. The pressure reducer chamber is provided with the first stage relief valve assembly to protect the regulator against overpressures.

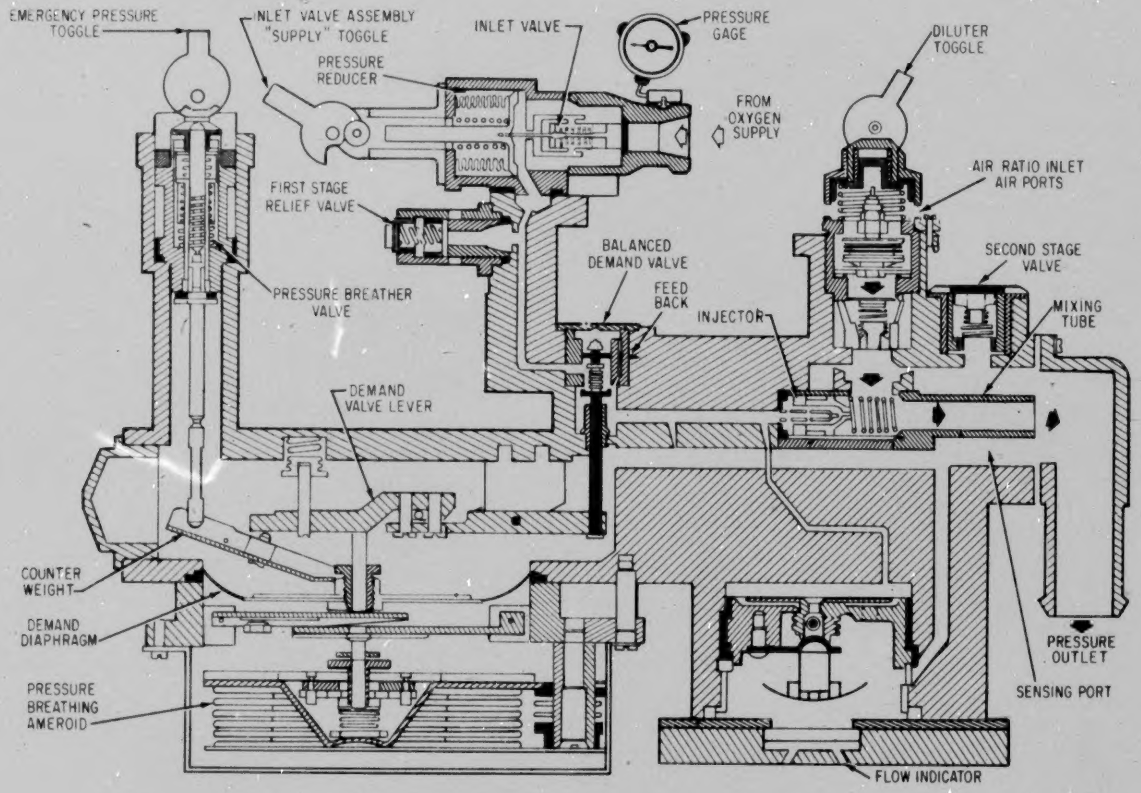
The demand valve assembly is opened when the pressure differential across the demand diaphragm forces down the demand valve lever assembly. The pressure differential exists during the inhalation cycle of the user by creating a reduction in the pressure outlet. Reductions in pressure at the pressure outlet are sensed in the demand diaphragm chamber through the sensing port.

During periods of flow, the oxygen passes through the injector assembly. At the injector assembly the flow of oxygen mixes with ambient air which enters the regulator through the inlet ports. The addition of ambient air to the oxygen is controlled by the manual diluted


BELOW 12,000 FEET
INHALING
VALVE OPEN
ANEROID ASSEMBLY COMPRESSED
NORMAL OXYGEN
AIR IN
TO MASK
OXYGEN
AIR
AIR-OXYGEN
POSITIVE PRESSURE
AT 32,000 FEET AIR PASSAGE CLOSES
INHALING
VALVE OPEN
SAFETY ANEROID
PRESSURE EXPANDED
100 % OXYGEN
AIR IN CLOSED
TO MASK
AT ABOUT 43,000 FEET
INHALING
VALVE OPEN
PRESSURE BREATHING ANEROID EXPANDING
PRESSURE BREATHING
AIR IN CLOSED
TO MASK

AM.581

Figure 6-2.—Automatic safety pressure operational schematic diagram.


EMERGENCY PRESSURE TOGGLE
INLET VALVE ASSEMBLY "SUPPLY" TOGGLE
PRESSURE REDUCER
INLET VALVE
PRESSURE GAGE
FROM OXYGEN SUPPLY
DILUTER TOGGLE
AIR RATIO INLET AIR PORTS
FIRST STAGE RELIEF VALVE
BALANCED DEMAND VALVE
FEED BACK
INJECTOR
SECOND STAGE VALVE
MIXING TUBE
PRESSURE BREATHER VALVE
DEMAND VALVE LEVER
COUNTER WEIGHT
DEMAND DIAPHRAGM
PRESSURE BREATHING AMEROID
PRESSURE OUTLET
SENSING PORT
FLOW INDICATOR

AM.582

Figure 6-3.—MD-1 Regulator schematic.

toggle and by the diluter aneroid assembly, automatically producing a 100 percent oxygen concentration at altitudes above 32,000 feet.

The diluter aneroid check valve assembly prevents a flow of oxygen out through the inlet ports. The emergency pressure toggle applies force to the emergency pressure control test spring, which mechanically loads the outer diaphragm through the control lever and center assembly. Mechanical loading of the outer diaphragm provides positive pressure at the regulator outlet.

Automatic pressure and pressure breathing at altitudes above 30,000 feet are provided through pneumatic actuation of the pressure breathing aneroid assembly. This function begins at near 27,000 feet altitude. The force exerted on the demand diaphragm assembly by the aneroid assembly actuates the pressure breather valve assembly, and oxygen flows to the diaphragm and plate assembly. The diaphragm and plate assembly is pressure loaded by this volume of oxygen actuating on the demand valve lever assembly to the extent that positive pressure is built up at the outlet as the altitude is increased. Additional safety is obtained through the inclusion of the second stage relief valve assembly in the regulator.

OPERATIONAL TESTING.–The following procedure should be followed prior to flights requiring the use of oxygen equipment for breathing. Place the supply inlet toggle in the SUPPLY ON position. Place the diluter toggle in the NORMAL OXYGEN position. Connect the oxygen mask hose to the quick connect, place mask to face, and check out function of the mask in the prescribed manner.

While at ground level, the regulator will not normally supply oxygen from the supply system to the mask. The emergency toggle must therefore be used in order to check out the oxygen supply function of the regulator at low altitudes. The emergency toggle is spring-loaded in the TEST MASK position and will return to NORMAL position under typical operating conditions.

TROUBLESHOOTING.–Troubleshooting information for the regulator is shown in table 6-3.

During the performance of any maintenance task, the job is not complete until the necessary maintenance data collection subsystem (MDCS) forms have been completed. Figure 6-4 shows an example of a single copy MAF used to document the work performed.

NOTE: More detailed instructions for completing maintenance data collection subsystem (MDCS) forms are covered in Military Requirements for Petty Officers 3 and 2, NavPers 10056 (Series), chapter 14, and OPNAV Instruction 4790.2 (Series).

AIRCRAFT LIQUID OXYGEN SYSTEMS

The AME1 or AMEC is responsible for the servicing and general maintenance of aircraft liquid oxygen systems. It is likely that the majority of the routine maintenance functions required to be performed on aircraft liquid oxygen systems will be performed on aircraft liquid oxygen systems will be performed by lower rated personnel under the instruction and supervision of the AME1 or AMEC. There are requirements of a more advanced nature in which the AME2 must demonstrate proficiency prior to advancement to AME1. They are as follows: Knowledge of the procedures and equipment used in testing liquid oxygen systems; analysis, diagnosis, and prescription of corrective action of oxygen system malfunctions; and procedures for prevention and detection of liquid oxygen contamination.

TYPICAL SYSTEM OPERATION

A typical liquid oxygen system, currently used in the F-4B aircraft, is illustrated in figure 6-5. This system, like other liquid oxygen systems, is considered to be a low-pressure system.

Two types of oxygen converters may be utilized in the F-4B aircraft oxygen system. One converter has an integral supply line check valve and combination pressure opening and closing valves. The second type converter, which is illustrated in figure 6-5, does not have a converter check valve or pressure opening valve. Since the first type of converter mentioned is discussed in the AME 3 & 2 training manual, only the latter is discussed here.

Like most other liquid oxygen systems, this system has three sequences of operation–fill, buildup, and supply.

The fill sequence begins when the external filler nozzle from the liquid oxygen filling cart is connected to the filler valve. The hose nozzle, when attached to the fill, buildup, and vent valve, actuates a plunger within the valve, which places the valve in the vent position. (See fig. 6-5 (A).) The valve, when in the vent position, provides an opening from the top of the converter to the atmosphere. This is utilized to vent gaseous oxygen during filling and liquid after the converter is full. During liquid transfer, liquid oxygen flows into the converter through the bottom of the converter. This arrangement allows gaseous oxygen to vent through the converter top as it is being displaced by liquid flow in the bottom. When the converter is completely full, liquid flows overboard through the vent line. Removal of the transfer nozzle from the fill, buildup, and vent valve automatically places the system in the buildup phase.

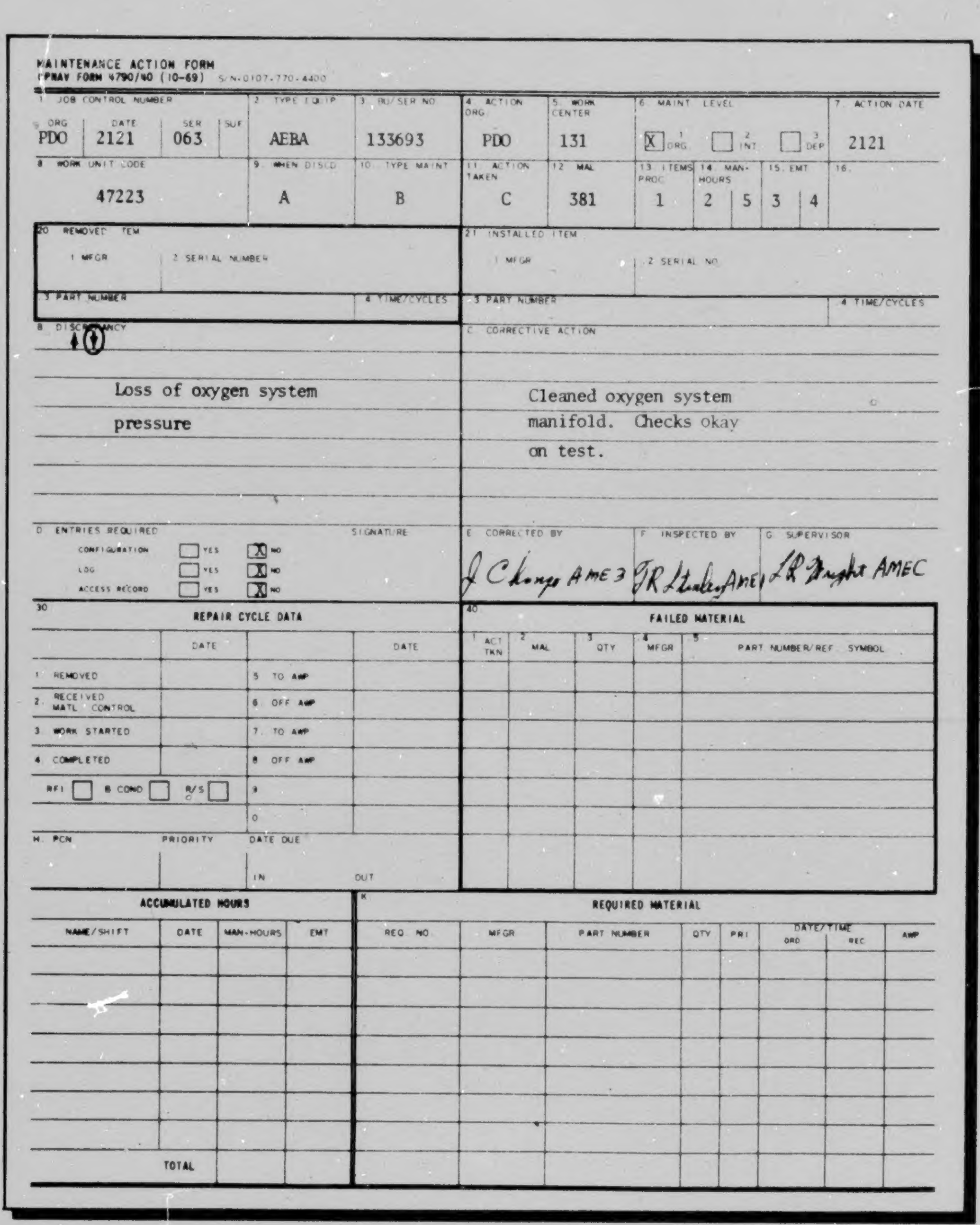
The buildup sequence of operation provides rapid pressure buildup to normal operation pressure as illustrated in figure 6-5 (B). During

Table 6-3.–Regulator troubleshooting chart.

Trouble	Probable cause	Remedy
Oxygen cylinder pressure gage fails to indicate proper pressure with fully charged pressure source.	Defective gage. Blocked or leaking supply line. Defective manifold inlet assembly.	Replace regulator. Replace or clean supply line to regulator. Replace regulator.
Oxygen not available at mask with proper source to regulator and other than EMERGENCY setting on regulator.	Regulator controls improperly positioned. Hose to mask is kinked. Regulator not functioning properly.	Correct position of controls. Straighten hose and reposition. Replace regulator.
Oxygen available at mask but no flow is indicated.	Defective blinker assembly.	Replace regulator.
Oxygen not available at mask with proper pressure source to regulator and regulator control set at EMERGENCY.	Kink or other malfunction between hose and mask. Faulty linkage from emergency toggle.	Replace or readjust equipment as necessary. Replace regulator.
Gage pressure drops when regulator is not in use.	Loose or leaking connections. Defective manifold.	Tighten or replace connection as necessary.
Improper mixture of air to oxygen.	Defective regulator.	Replace regulator.
Panel lights fail to light.	Burned out lamp. Faulty light assembly. Faulty electrical hookup to power source.	Replace lamp. Replace regulator. Repair electrical hookup.

this phase, liquid oxygen from the liquid container fills the buildup coil by gravitational feed. The liquid in the coil absorbs heat from the coil and vaporizes, which causes a pressure buildup. Gaseous oxygen formed in the coil then circulates through the pressure closing valve and back to the top of the converter, which enables more liquid to flow into the buildup coil. This circulation and pressure buildup continues until approximately 72 psi is reached, at which time the pressure closing valve closes. This action prevents rapid liquid evaporation and consequently fast boil-off (venting).

The normal supply sequence begins during the buildup phase and continues until all liquid oxygen has evaporated from the system. (See fig. 6-5 (C).) When the aircrewman turns the oxygen ON/OFF valve to the ON position, liquid oxygen is drawn from the bottom of the converter. As the liquid flows through the supply line and warmup plate, vaporization occurs which provides gaseous oxygen for



MAINTENANCE ACTION FORM
OPNAV FORM 4790/40 (10-69) S/N-0107-770-4400

1. JOB CONTROL NUMBER ORG	DATE	SER	SUF	2. TYPE EQUIP	3. BU/SER NO	4. ACTION ORG	5. WORK CENTER	6. MAINT LEVEL	7. ACTION DATE
PDO	2121	063		AEBA	133693	PDO	131	☒ 1 ORG ☐ 2 INT ☐ 3 DEP	2121

8. WORK UNIT CODE	9. WHEN DISCD	10. TYPE MAINT	11. ACTION TAKEN	12. MAL	13. ITEMS PROC	14. MAN-HOURS		15. EMT		16.
47223	A	B	C	381	1	2	5	3	4	

20 REMOVED ITEM
1 MFGR
2 SERIAL NUMBER
3 PART NUMBER
4 TIME/CYCLES

21 INSTALLED ITEM
1 MFGR
2 SERIAL NO
3 PART NUMBER
4 TIME/CYCLES

B DISCREPANCY ↑①

Loss of oxygen system pressure

C CORRECTIVE ACTION

Cleaned oxygen system manifold. Checks okay on test.

D ENTRIES REQUIRED SIGNATURE
CONFIGURATION ☐ YES ☒ NO
LOG ☐ YES ☒ NO
ACCESS RECORD ☐ YES ☒ NO

E CORRECTED BY	F INSPECTED BY	G SUPERVISOR
J Chong AME 3	JR Steele AME1	LR Wright AMEC

30 **REPAIR CYCLE DATA**

	DATE		DATE
1 REMOVED		5 TO AWP	
2 RECEIVED MATL CONTROL		6 OFF AWP	
3 WORK STARTED		7 TO AWP	
4 COMPLETED		8 OFF AWP	
RFI ☐ B COND ☐ R/S ☐		9	
		0	

H. PCN PRIORITY DATE DUE IN OUT

40 **FAILED MATERIAL**

1 ACT TKN	2 MAL	3 QTY	4 MFGR	5 PART NUMBER/REF SYMBOL

ACCUMULATED HOURS

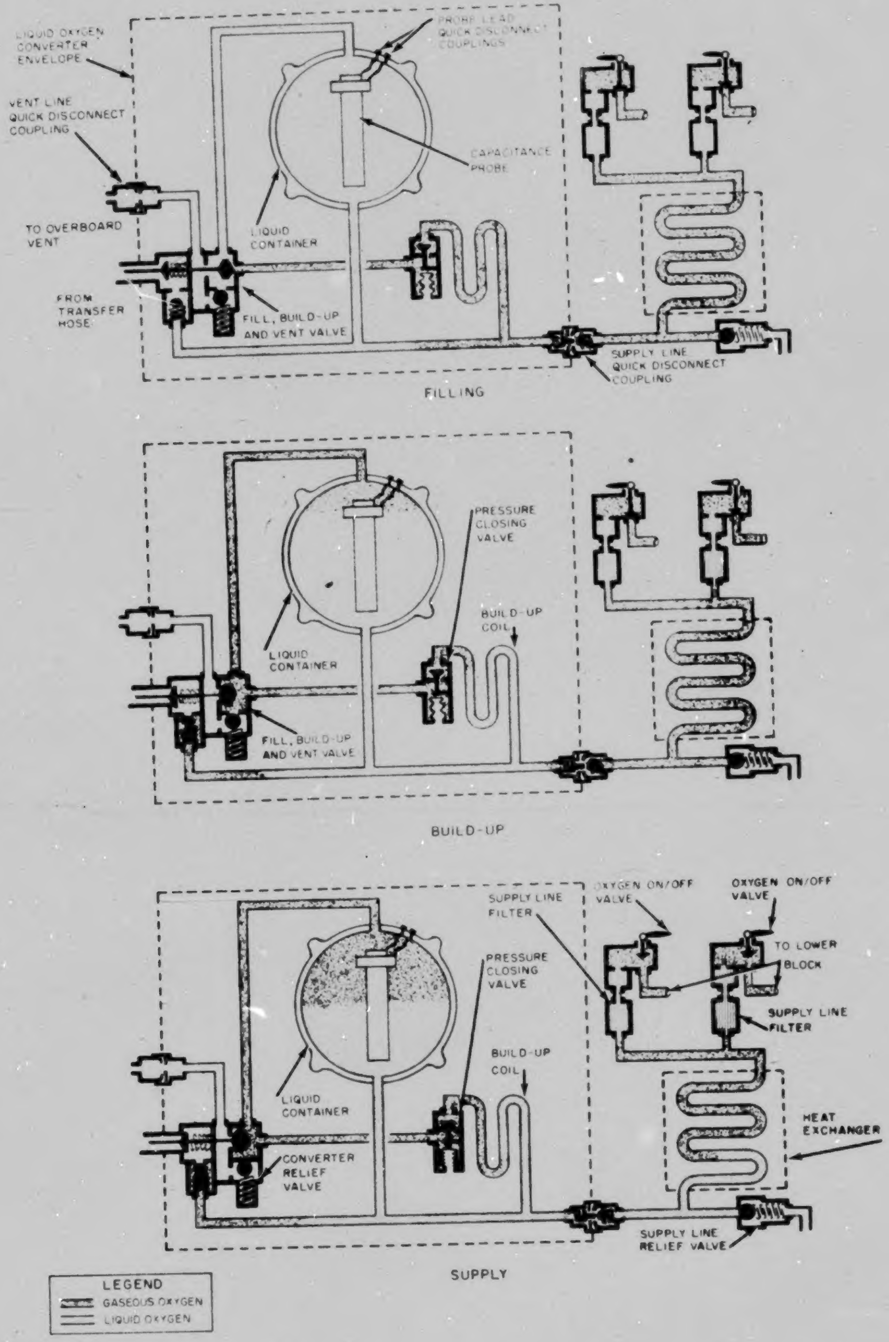
NAME/SHIFT	DATE	MAN-HOURS	EMT
TOTAL			

K **REQUIRED MATERIAL**

REQ NO	MFGR	PART NUMBER	QTY	PRI	DATE/TIME ORD	DATE/TIME REC	AWP

AM.606

Figure 6-4.—Example of MAF used to document work performance.


LIQUID OXYGEN CONVERTER ENVELOPE
VENT LINE QUICK DISCONNECT COUPLING
TO OVERBOARD VENT
FROM TRANSFER HOSE
PROBE LEAD QUICK DISCONNECT COUPLINGS
CAPACITANCE PROBE
LIQUID CONTAINER
FILL, BUILD-UP AND VENT VALVE
SUPPLY LINE QUICK DISCONNECT COUPLING
FILLING
PRESSURE CLOSING VALVE
BUILD-UP COIL
LIQUID CONTAINER
FILL, BUILD-UP AND VENT VALVE
BUILD-UP
OXYGEN ON/OFF VALVE
OXYGEN ON/OFF VALVE
SUPPLY LINE FILTER
TO LOWER BLOCK
PRESSURE CLOSING VALVE
SUPPLY LINE FILTER
BUILD-UP COIL
LIQUID CONTAINER
HEAT EXCHANGER
CONVERTER RELIEF VALVE
SUPPLY LINE RELIEF VALVE
SUPPLY
LEGEND
GASEOUS OXYGEN
LIQUID OXYGEN

AM.583

Figure 6-5.—Liquid oxygen system operation.

breathing and also aids pressure buildup in the system. As system pressure increases to approximately 72 psi, the pressure closing valve closes, preventing rapid evaporation of the liquid to continue. If the pressure is lowered by crew consumption, the pressure closing valve opens, allowing the pressure to again build up. When oxygen is not being used, the pressure continues to increase by normal evaporation until it reaches a value equal to the relief valve setting. At this point, the relief valve opens, allowing excess pressure to escape from the system.

NOTE: Pressure values called out in the foregoing operational description of a liquid oxygen system are typical. When checking the operation of specific systems, reference must be made to the aircraft Maintenance Instructions Manual for exact pressures applicable to the system at hand.

MAINTENANCE

Maintenance by the AME is limited to servicing, testing, and troubleshooting the system. Component repair and shop testing are performed by personnel of the PR rating.

WARNING: When performing maintenance on liquid oxygen systems, insure that all safety measures and precautions are adhered to or severe injury to personnel and damage to aircraft and equipment can occur.

Evaporation Loss Test

The evaporation loss test should be conducted after maintenance has been performed on the system, such as removal of lines, fittings, disconnects, valves, etc. The procedure for performing this test follows:

1. Insure that ON/OFF valves are in the OFF position.
2. Fill the system to capacity with liquid oxygen, following instructions in the applicable Maintenance Instructions Manual.
3. Allow the system to stabilize from 1 to 2 hours. The converter must be allowed to cool down as far as the ambient temperature will allow.
4. Apply power to the quantity indicating circuit and mark the position of the liquid quantity indicator with a strip of tape or a crayon mark.
5. Allow the system to stand for 24 hours.
6. At the end of the 24 hours, apply power again and check the position of the indicator pointer. The evaporation loss should not have exceeded 1 to 1-¼ liters. Exact allowable loss during this test may be ascertained by referring to the applicable Maintenance Instructions Manual.

Pressure Loss Test

It sometimes becomes necessary to conduct a test for suspected pressure leakage in a liquid oxygen system. The test is known as a pressure loss test. It is accomplished by draining and purging the system, pressurizing it to a pressure at or near its operating pressure with gaseous oxygen, allowing the system to cool for 15 minutes to ½ hour, and then checking for a pressure drop during the next 30 minutes.

Most manufacturers recommend use of a pressure gage kit which in some cases is adaptable for use only on their own aircraft. The kit consists of a low-pressure (usually 0 to 150 psi) direct-reading gage and suitable lines and fittings for rapidly connecting the test assembly to the system. The testers are variously connected to the filler valve, supply line quick-disconnects, special fittings on pressure-opening/pressure-closing valves or other convenient places, depending upon the aircraft model and the manufacturer's recommendations. Prior to commencing the test, it should be absolutely ascertained that NO liquid oxygen remains within the system. Residual liquid oxygen will vaporize and expand and, if a leak is present, compensate for the lost gaseous oxygen and the gage will show no pressure drop when, in reality, an unacceptable leakage rate exists.

Charge the system to a pressure within its operating range (about midway between the settings of the pressure-opening and pressure-closing valves). After a 15- to 30-minute wait to allow temperatures to stabilize, mark the exact position of the test gage indicator needle. Check the needle after 30 more minutes. As a general rule, the pressure drop for a 10-liter system should not exceed 6 psi and for 20-liter system, 4 psi. However, due to aircraft size and configuration, a 10-liter system on one aircraft model may not have the same internal volume as a 10-liter system in another aircraft model. Therefore, the values furnished in this chapter are typical of aircraft liquid oxygen systems in general. The contractor's recommendations in the manner of connecting the test gage assembly, the proof pressure values, and the allowable pressure drop should always be ascertained from the applicable Maintenace Instructions Manual prior to beginning the test.

CONTAMINATION CONTROL

Liquid oxygen must be handled with extreme care at all times due to its high affinity for most forms of contamination. A contaminated supply may cause noxious and nauseating odors which adversely affect pilot proficiency and cause malfunction of liquid oxygen equipment. For these reasons, all personnel working with liquid oxygen ground support equipment and aircraft systems should take every possible precaution to maintain the quality of the liquid oxygen supply and to prevent contaminants from being introduced into the supply at any time.

To prevent liquid oxygen contamination:

1. Never store liquid oxygen in or around areas in which odors of any type may be absorbed by the liquid oxygen. It should be remembered that liquid oxygen has a high affinity for many gaseous compounds.
2. Extreme care should be taken to insure that dirty or oily equipment is never used with liquid oxygen equipment.
3. Keep liquid oxygen transfer hoses capped at all times except during transfer operations.
4. At the beginning of each servicing operation the transfer hose should be purged until liquid flows before connecting it to the aircraft filler valve.
5. Liquid oxygen storage tanks, servicing trailers, or aircraft systems should never be allowed to go dry and be exposed to the atmosphere. When liquid oxygen equipment is emptied for any reason, it should be closed to the atmosphere in order to prevent the introduction of water vapor or odor.

NOTE: Liquid oxygen storage tanks, servicing trailers, and aircraft systems which have been allowed to run dry must be purged in accordance with existing directives.

When and wherever operations permit, use the following operational procedures:

1. Establish a set time for the transfer of liquid oxygen from the storage tank to the servicing trailer.
2. Use a minimum number of servicing trailers for each squadron. Maintain surplus trailers in a ready condition, closed off from the atmosphere but not filled with liquid oxygen. Prior to use always purge the surplus servicing trailers.
3. Whenever possible, service aircraft system just prior to flight and keep the number of daily refills per aircraft to a minimum.
4. Service the maximum number of aircraft consecutively from the same servicing trailer.

Normally, an operation logbook is attached to, or stored on, ground servicing equipment. Information listed in this logbook will aid in tracing sources of contamination as well as providing information for contamination reports.

Detection

Liquid oxygen contamination is detected by means of an odor test, sampling and analysis, and pilot complaint. The exact amount and kind of contamination is determined by a laboratory analysis of the liquid oxygen sample.

The odor test should be made on liquid oxygen systems after every dry purge or wet cleaning and at such other times as contamination is suspected.

Taking samples of liquid oxygen from converters installed in aircraft is generally not practical nor desirable. If a converter suspected of containing unsuitable oxygen cannot be removed from the aircraft because of lack of time or other reason, it is best to purge the system and take a sample from the trailer or storage tank that originally supplied the aircraft.

Purging

Purging is a procedure to remove contaminants from containers by flushing out the contents of the container with hot, dry, gaseous nitrogen or oxygen. One of the principal contaminants is moisture, which may short the converter probes. The purging gas is heated so that any moisture in the container will be removed. Under existing instructions, purging is authorized to be accomplished by cognizant personnel at fleet level.

It is mandatory to purge the liquid oxygen system if it has been empty for a specified amount of time, if it has been opened for repairs or replacement of components, or if it is suspected of being contaminated.

OPERATION. To purge a liquid oxygen system, the AME must first insure that all electrical power is off in the aircraft and the aircraft is electrically grounded. Only then will the AME perform the following steps:

1. Drain the liquid oxygen from the converter system and allow the system to warm up to ambient temperature. This will conserve large quantities of purging gas.
2. Connect the purging adapter to the converter filler valve.
3. Connect the purging heater between the purging adapter and a source of dry, oil-free nitrogen, Specification MIL-N-6011, or gaseous oxygen, Specification MIL-O- 27210C (Type I).
4. Regulate the gas supply pressure and temperature as specified in the specific aircraft Maintenance Instructions Manual. When using nitrogen, the system is normally purged for at least 2 hours (at 50 psi; exit gas should be over 100°F). Oxygen being used as the purging supply normally reduces the purging time.
5. Stop the gas flow.
6. Disconnect the purging gas source from the adapter and the adapter from the converter filler valve.
7. Fill the system immediately with liquid oxygen. As the converter becomes full, use a small, clean beaker to collect a 200-cc sample of oxygen that vents overboard and conduct an odor test as described earlier in this chapter.
8. Use an oxygen mask and smell the aircraft oxygen supply to detect odors. If odors persist after this purging operation, or if a short is still indicated in the probe, repeat the purging operation.

NOTE: If odors persist after the purging operation, arrange for the equipment to be cleaned by an approved Naval Air Rework Facility.

WARNING: Due to the hazards involved when handling liquid oxygen, the following safety precautions must be exercised:

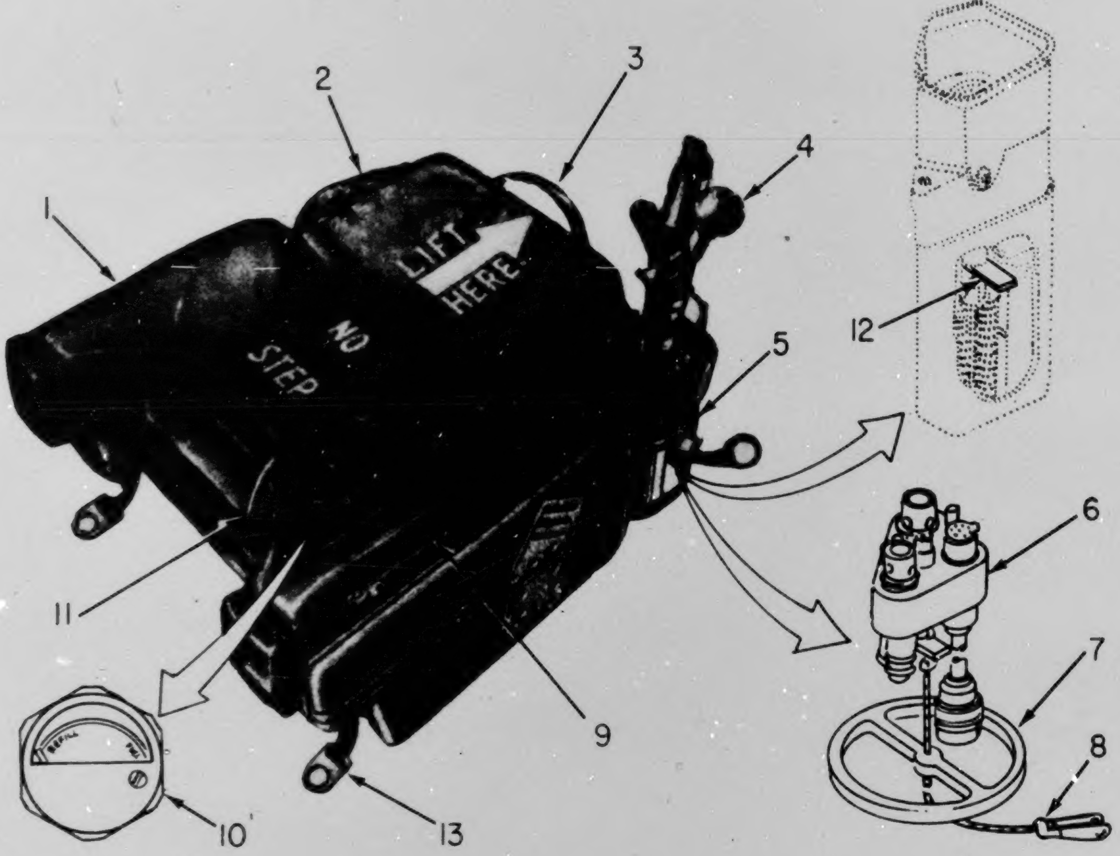
1. The area in the vicinity of the aircraft must be open, well ventilated, and free of oil, grease, and other highly combustible liquids.
2. The aircraft must not be refueled during liquid oxygen servicing.
3. Electrical power should not be applied, and the aircraft must be well grounded.
4. At least two qualified men must be present during the operation.
5. Servicing personnel must be qualified to handle liquid oxygen.
6. A CO_2 extinguisher should be available, and any flame-producing activity must not be less than 50 feet from the servicing operation.

SURVIVAL KIT SYSTEMS

The AME, in the performance of his duties, is responsible for maintaining several types of survival kits. Survival kits installed in ejection seats are similar in appearance as well as operation. The major difference is their oxygen system design. The survival kit discussed in this chapter is the RSSK-1 and 1A used in the F-4B aircraft. The kit is illustrated in figure 6-6.

The survival kit system provides emergency and normal equipment for survival and support of the crew during high-altitude bailout, overwater survival, and for normal flight conditions. The main parts of the system are the survival kit, composite disconnect upper block, ventilating air exhaust hose, and composite disconnect lower block. The main component of the system is the survival kit, which provides a mounting for all components of the kit and fits in the seat bucket of the ejection seat. The container, intermediate block, LR-1 pararaft, seat cushion, emergency oxygen cylinder, and pressure reducer manifold constitute the majority of the kit components.

The container is a two-piece Fiberglass unit, generally rectangular in shape, consisting of an upper and lower half. The upper half of the container, generally referred to as the lid, hinges on the lower half at the forward end of the container and serves as a mounting for the

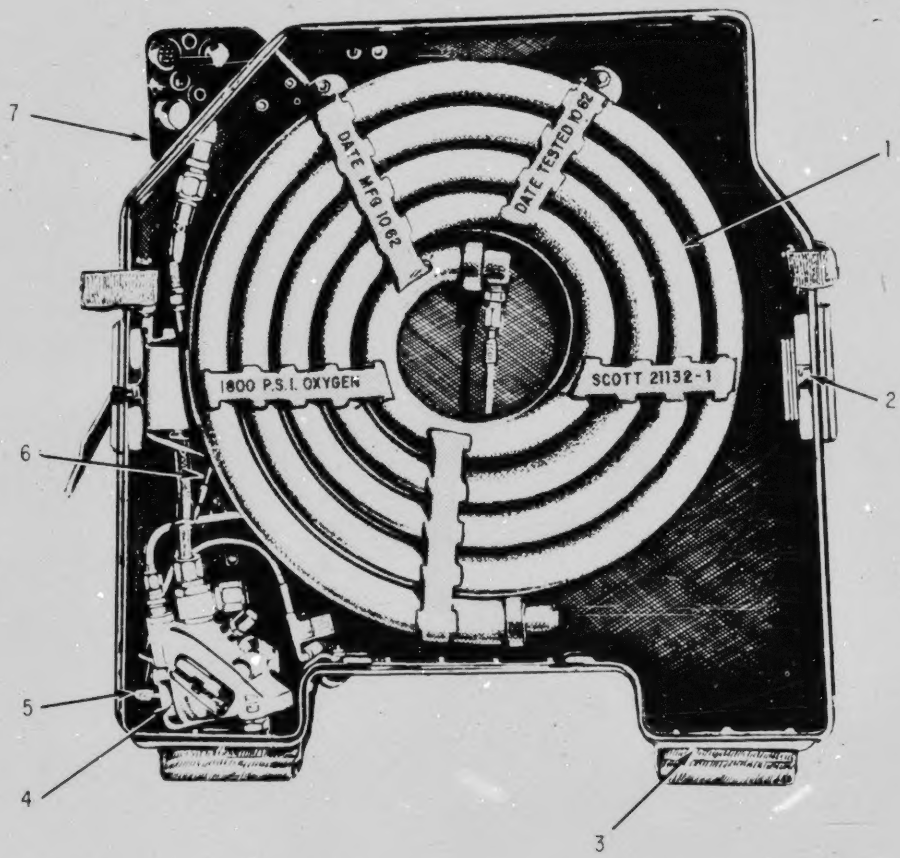

1
2
3
4
LIFT HERE
NO STEP
5
12
6
11
REFILL
FULL
9
7
8
10
13

1. Survival Kit.
2. Kit release handle.
3. Lift handle.
4. Upper block.
5. Intermediate block.
6. Lower block.
7. Lower block release ring.
8. Lower block release lanyard.
9. Cushion.
10. Emergency oxygen pressure gage.
11. Emergency oxygen manual release ring.
12. Lower block locking indicator flag.
13. Negative-G holddown ring.

Figure 6-6.–Ejection seat survival kit.

emergency oxygen cylinder and pressure reducer manifold. (See fig. 6-7).

The two locking hooks on the upper half mate with latch mechanisms on the lower half, providing a means of locking the two halves together. The lower half of the container provides space for the various articles of the LR-1 pararaft kit and a mounting for the kit release


7
1
DATE MFG 10 62
DATE TESTED 10 62
1800 P.S.I. OXYGEN
SCOTT 21132-1
2
6
5
4
3

AM.636

1. Emergency O_2 cyclinder.
2. Lid Lock hook (R.H.).
3. Lid hinge.
4. Pressure reducer manifold.
5. Toggle arm.
6. Lid lock hook (L.H.).
7. Intermediate block.

Figure 6-7.—Survival kit container, upper half.

handle and handle mechanism. Located on the left aft corner of the kit is the intermediate block of the composite disconnect. This block provides support and a mating surface for the upper and lower blocks.

On top of the kit, a foam rubber cushion is attached by snap fasteners and a zipper. An inspection hole is located on the forward end of the cushion to allow checking of the emergency oxygen supply pressure indicator. An arrow, accompanied by the words "LIFT HERE," is located on the aft end of the cushion, indicating the location of the carrying handle for the kit.

In general, the functions of the survival kit are as follows:

1. Provides a seat cushion for the aircrewman.
2. Maintains emergency oxygen for breathing during descent from high altitude after ejection or when a failure of the aircraft system occurs.
3. Provides equipment for survival when ditching occurs over water.
4. Contains a quick disconnect for the upper block, which provides the aircrewman with a fast method of separating from the kit.
5. Provides a connection for the oxygen and communications from the aircraft to the aircrewman.

OPERATION

Various survival kit functions which occur during normal flight, ground handling, and emergency conditions consist of normal or emergency operation. Normal operation of the kit occurs when the systems in the aircraft are operating normally and all emergency features of the kit are not being used.

During normal operation, the kit is utilized to support the occupant wearing the standard flight suit. In all phases of normal operation, the kit provides a cushion for the occupant and a routing for breathing oxygen and communications from the aircraft to the occupant. When the occupant wears the standard flight suit, the standard suit upper block is used on the kit which routes oxygen and communications to the face mask. NOTE: Information on the composite quick-disconnect blocks can be found in AME 3 & 2, NavTra 10309 (Series).

Emergency operation of the kit occurs during the ejection sequence and when various system failures of the aircraft require use of the survival kit's emergency features. Emergency breathing oxygen is obtained from the kit when failure of the normal oxygen system occurs by manually pulling the emergency oxygen release ring. (See fig. 6-6.)

If ejection occurs over water, the LR-1 pararaft is inflated when approaching the water surface. Inflation of the raft is accomplished by manually actuating the kit release handle. (See fig. 6-6.) When the handle is pulled upward, cable linkage within the kit separates the upper and lower halves of the container and trips the CO_2 cylinder of the pararaft.

MAINTENANCE

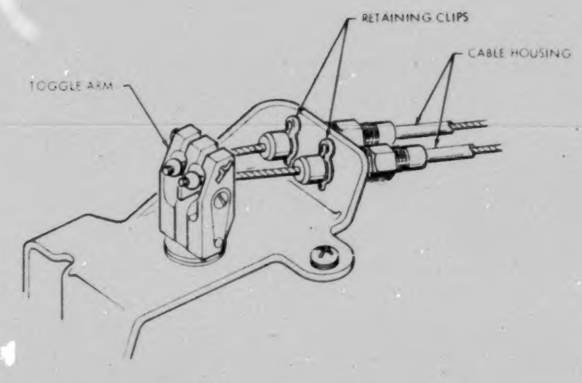
Maintenance on the survival kit is not normally accomplished by AME's. All malfunctions and replacement of components as well as adjustments are made by personnel of the PR rating.

AME's are responsible for servicing the oxygen cylinder, and for installation and removal of the survival kit.

Oxygen Servicing

During servicing of the emergency oxygen cylinder, insure that all safety precautions concerning oxygen are strictly adhered to where applicable.

To service the cylinder, the left-hand front corner of the cushion is unfastened and lifted upward. This allows for the removal of the snap plugs from the container in order to gain access to both the toggle arm and filler valve. Cock the toggle arm on the pressure reducer manifold. This will maintain the emergency oxygen supply in the oxygen cylinder. After cocking, check for false cock and inspect the toggle for proper position–the actuating cable ball ends must be in the retaining cavities of the toggle arm as shown in figure 6-8. Remove the protective cap from the filler valve and install the filler valve adapter. After purging the oxygen supply hose, connect it to the filler adapter.



AM.588
Figure 6-8.—Pressure reducer manifold toggle (cocked position).

CAUTION: Open the valve of the oxygen source slowly to prevent damage to equipment from high temperature and pressure surges.

Using the proper filling method, turn on the oxygen source and allow the cylinder to fill to the specified pressure as indicated in the applicable Maintenance Instructions Manual. When the cylinder is full, close the valve on the oxygen source and slowly loosen the connection from the filler adapter; also, remove the filler adapter from the filler valve and check filler valve for leakage. Servicing is then completed by installing the filler valve protective cap, installing the snap plugs in the container, and attaching the cushion to the kit.

Installation and Removal

Removal of the survival kit from the ejection seat is necessary in order to perform required maintenance tasks. This removal, although a simple operation, must be accomplished in a step-by-step manner to eliminate damage to the kit as well as unnecessary actuation of the kit's systems.

The removal of the survival kit is normally accomplished by one man. Insure the safety strut is installed on the canopy actuating cylinder, all pins of the ejection seat ground safety pin assembly are installed, and the secondary ejection handle guard is rotated upward.

Pull upward on the upper block release knob until the upper block separates from the kit (fig. 6-9, view A). On rocket assist ejection seats, fold the lumbar pad forward and secure the lap belt and fitting to the plane captain's D-ring on the opposite lap belt and cinch the lap belt up tight around the lumbar pad, (fig. 6-9, view B) to insure release of lap belts when harness release lever is actuated. Use the insertion device to hold the harness loop strap end fitting in the harness locking mechanism (fig. 6-9, view C).

After the device is in place, push down on the harness release lever (fig. 6-9, view D) to release all kit attaching straps, then allow the lever to return to the original position. On seats having rocket assist ejection, insure the springloaded harness locking plunger has engaged and is retaining the harness loop strap end fitting before removing the insertion device.

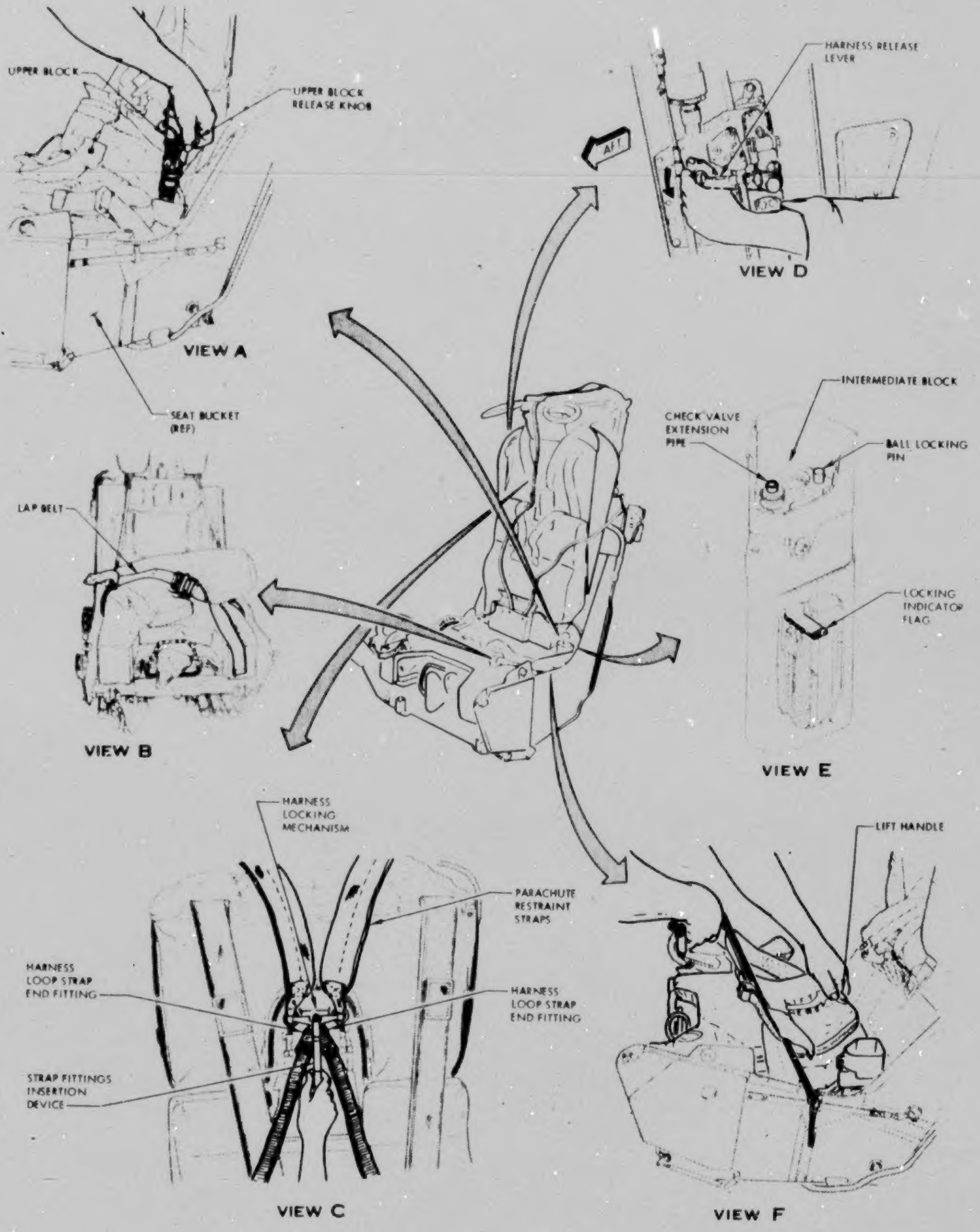
Check for extension of the ball locking pin on the top surface of the intermediate block. The pin should be above the top surface of the block as shown in figure 6-9, view E. Checking is accomplished by pushing the pin down and then releasing it. This pin must be in the extended position or emergency oxygen will be actuated when the lower block separates from the kit.

Locate the lift handle (fig. 6-9, view F) and raise the kit from the seat until the lower block separates. When the lower block is free, lift from seat and install maintenance dust plug assembly.

CAUTION: Do not lift the survival kit with the release handle.

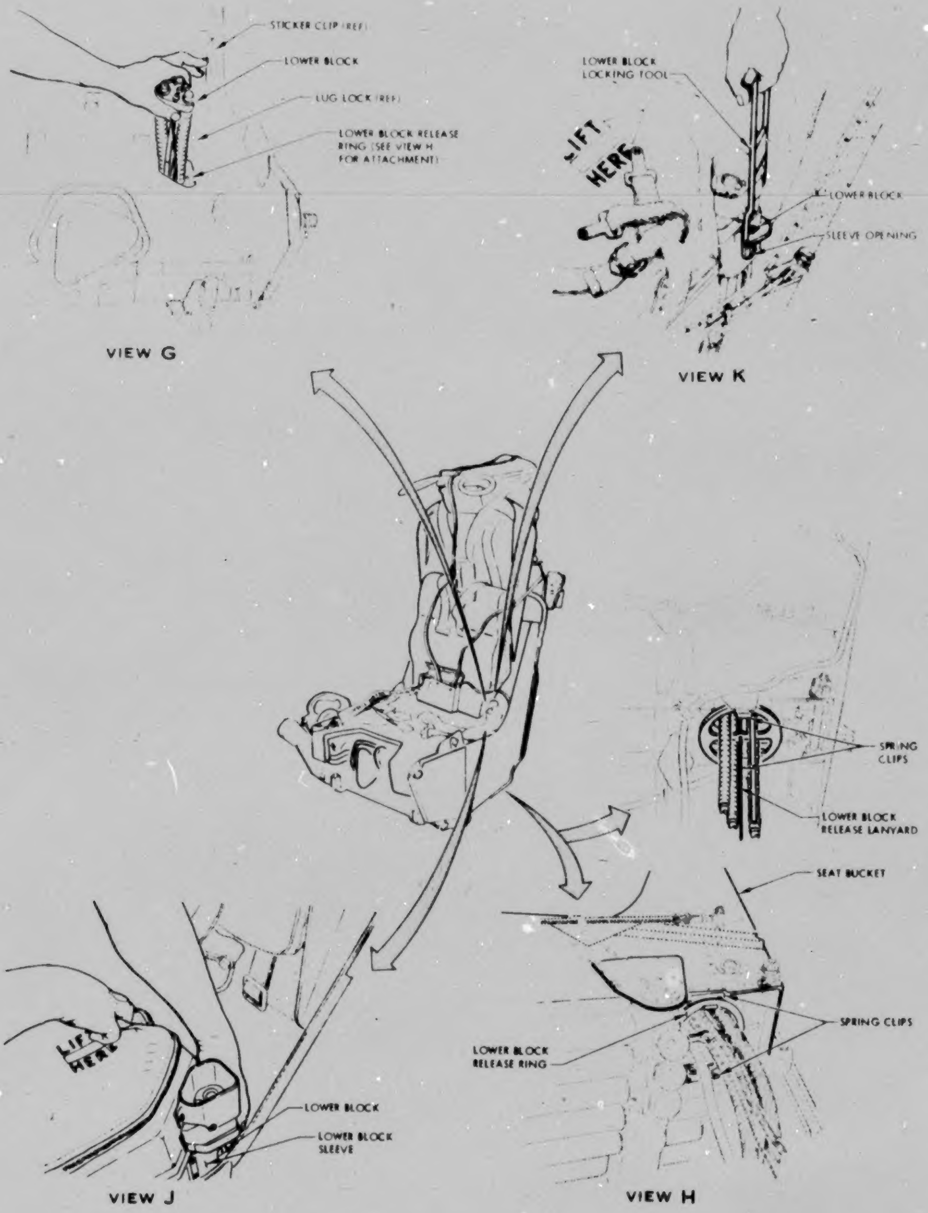
WARNING: On rocket assist ejection seats, survival kit weight must be 40 to 49 pounds. If these weight limits are exceeded, ejection performance may be adversely affected. Add ballast if required. Ballast, when required, consists of lead shot in a durable heat-sealed plastic bag, placed in the equipment container.

Installation of the survival kit also requires only one man. The lower block composite disconnect assembly is pulled up through the opening in the aft left corner of the seat bucket as illustrated in figure 6-9, view G. The block is inspected prior to installation for the following:


UPPER BLOCK
UPPER BLOCK RELEASE KNOB
VIEW A
SEAT BUCKET (REF)
HARNESS RELEASE LEVER
AFT
VIEW D
INTERMEDIATE BLOCK
CHECK VALVE EXTENSION PIPE
BALL LOCKING PIN
LOCKING INDICATOR FLAG
VIEW E
LAP BELT
VIEW B
HARNESS LOCKING MECHANISM
PARACHUTE RESTRAINT STRAPS
HARNESS LOOP STRAP END FITTING
HARNESS LOOP STRAP END FITTING
STRAP FITTINGS INSERTION DEVICE
VIEW C
LIFT HANDLE
VIEW F

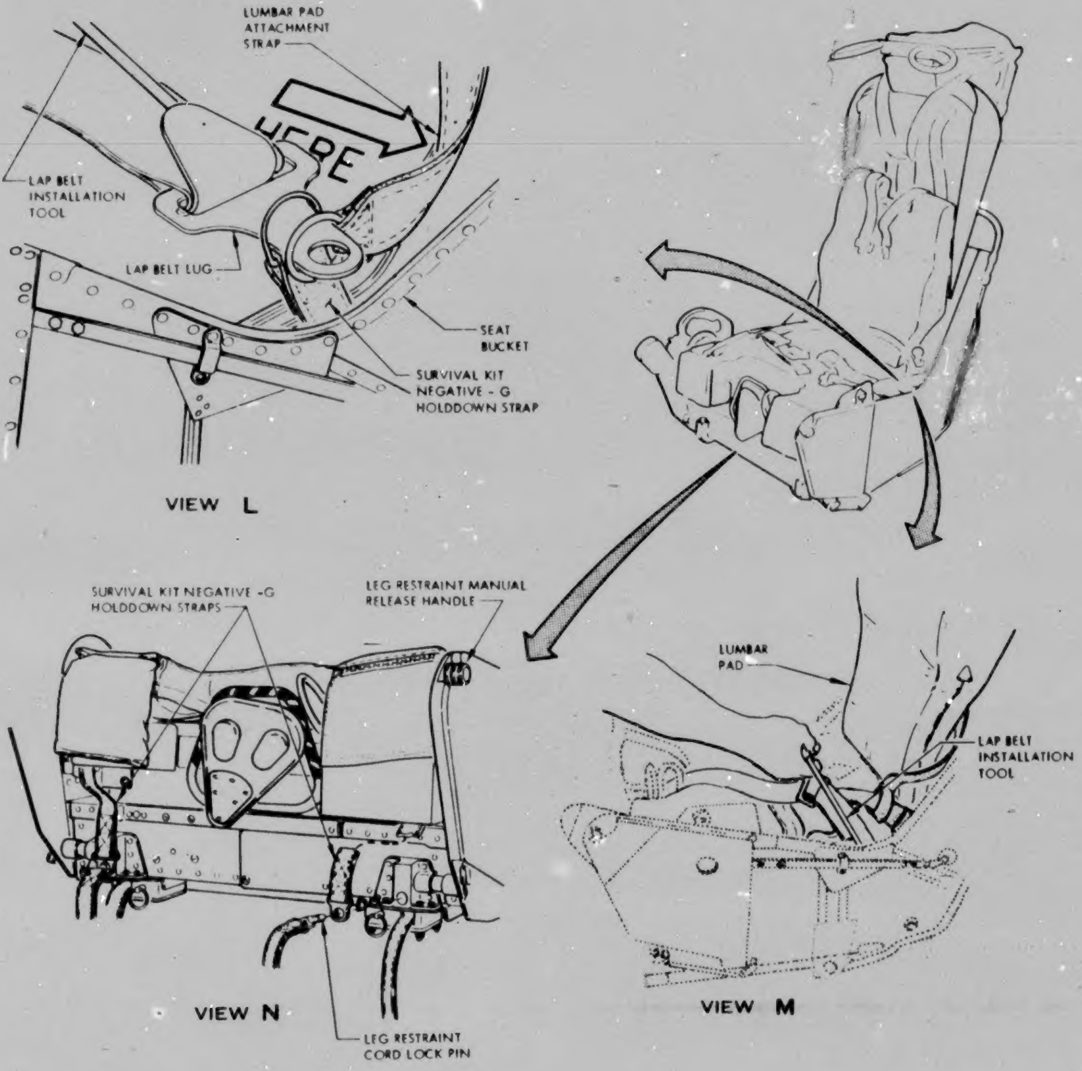
AM.607

Figure 6-9.–Survival kit removal and installation. (Sheet 1)


STICKER CLIP (REF)
LOWER BLOCK
LUG LOCK (REF)
LOWER BLOCK RELEASE RING (SEE VIEW H FOR ATTACHMENT)
VIEW G
LOWER BLOCK LOCKING TOOL
LIFT HERE
LOWER BLOCK
SLEEVE OPENING
VIEW K
SPRING CLIPS
LOWER BLOCK RELEASE LANYARD
SEAT BUCKET
LIFT HERE
LOWER BLOCK
LOWER BLOCK SLEEVE
VIEW J
LOWER BLOCK RELEASE RING
SPRING CLIPS
VIEW H

AM.608

Figure 6-9.—Survival kit removal and installation. (Sheet 2)


LUMBAR PAD ATTACHMENT STRAP
HERE
LAP BELT INSTALLATION TOOL
LAP BELT LUG
SEAT BUCKET
SURVIVAL KIT NEGATIVE - G HOLDDOWN STRAP
VIEW L
SURVIVAL KIT NEGATIVE -G HOLDDOWN STRAPS
LEG RESTRAINT MANUAL RELEASE HANDLE
LUMBAR PAD
LAP BELT INSTALLATION TOOL
VIEW N
VIEW M
LEG RESTRAINT CORD LOCK PIN

AM.609

Figure 6-9.–Survival kit removal and installation. (Sheet 3)

1. The condition of the seals and the exclusion of oil, grease, or any other foreign matter.
2. The condition and security of all attached service lines, and insure that the locking mechanism is cocked.
3. Hose clamps on service lines to the lower block must not extend beyond the profile of the lower block.
4. Lubricate exposed O-rings installed in the lower block with the lubricant that is specified

in the applicable Maintenance Instructions Manual.

Remove the maintenance dust plug from the lower block. While holding the kit by its carrying handle (fig. 6-9, view J), place the forward end of the kit down into the seat bucket. Using the other hand, reach behind and under the kit to insert the lower block assembly into the lower block sleeve. Push the block assembly up into the sleeve (with the fingers) a sufficient amount to allow insertion of the locking tool.

The locking tool is inserted through the slot in the composite disconnect sleeve and positioned so it bears against the lower surface of the block. (See view K, sheet 2.) Insure that the dowel pin on the tool is engaged in the suit pressure sensing hole of the lower block. While holding the lower block in position with the tool, lower the kit into the seat bucket. The disconnect sleeve should extend into the opening in the seat bucket. Then apply pressure with the knee on the kit and pull up on the locking tool until the block is locked. An audible click should be heard when the block locks in place.

The lower block must be checked for proper locking by inspecting the locking indicator flag illustrated in view E, sheet 1. A loose locking indicator flag indicates that the block has not locked properly. This is normally checked by flipping the flag lightly with the fingers. Also inspect the oxygen outlet port of the intermediate block. The extension pipe on the oxygen check valve in the intermediate block must extend above the top surface of the block. After completion of both checks, dust plugs are installed in the upper block cavities.

Installation of the lower harness requires the use of a special installation tool. Place the harness lug onto the lip of the tool, as illustrated in view L, sheet 3, with the tool on the inboard side of the lug and webbing. Insert the lug through the slot in the rear of the seat.

On survival kits with negative-G holddown straps, place the aft holddown strap ring on the lap belt lug prior to insertion (See fig. 6-9, view L.) On rocket assist ejection seats, also place the lumbar pad ejection strap ring on the lap belt lug. (See view L.) With the tool still attached, push in on the tool until the lug locks in place. (View M.) Pull against the lug with the tool attached to test lug engagement, then remove tool. Repeat for other side.

On rocket assist ejection seats, place the loop of the parachute container holddown straps on corresponding lap belt harness sticker strap lugs. Insert the two lap belt sticker lugs into the sticker clips. (See view G.)

On seats with negative-G holddown straps, place the rings of the forward straps on leg restraint cord lockpins and insert the pins into corresponding lock mechanism on front of seat. (See view N.) Install upper block and check for leakage.

CHAPTER 7

PRESSURIZATION AND AIR-CONDITIONING SYSTEMS

The cabin-air-conditioning and pressurization system supplies conditioned air for heating and cooling the crew spaces. This air also provides cabin pressurization to maintain the crewmembers in a safe, comfortable environment. In addition to cabin air-conditioning, some aircraft equipment and equipment compartments require air conditioning to prevent heat buildup and consequent damage to the equipment.

The majority of the air-conditioning systems installed in modern aircraft utilize air turbine refrigerating units to supply cooled air. These are called air cycle systems. One late model aircraft, the E-2A, utilizes a compressed gas cooling system for cooling of electronic equipment and electronic compartments. The refrigerating unit is a Freon type, quite similar in operation to common household refrigerators. Systems utilizing this refrigeration principle are called vapor cycle systems.

AIR CYCLE SYSTEM

The air cycle system described in this chapter is more representative of the F-4 installation than any other, though all are similar in operation.

The F-4 installation is separated into two systems, the cabin air-conditioning and pressurization system and the equipment air-conditioning system. Since the basic components of these two systems are so similar as to construction and operation, only the components of the cabin air-conditioning and pressurization system are described in detail in this chapter.

The system is composed of an air-to-air heat exchanger which operates automatically with either one or both engines running. This system is primarily a refrigeration unit consisting of a heat exchanger, cooling turbine, regulator and shutoff valves, mixing valves, ejector shutoff valve, exchanger, sensors, limiters, and temperature control panel.

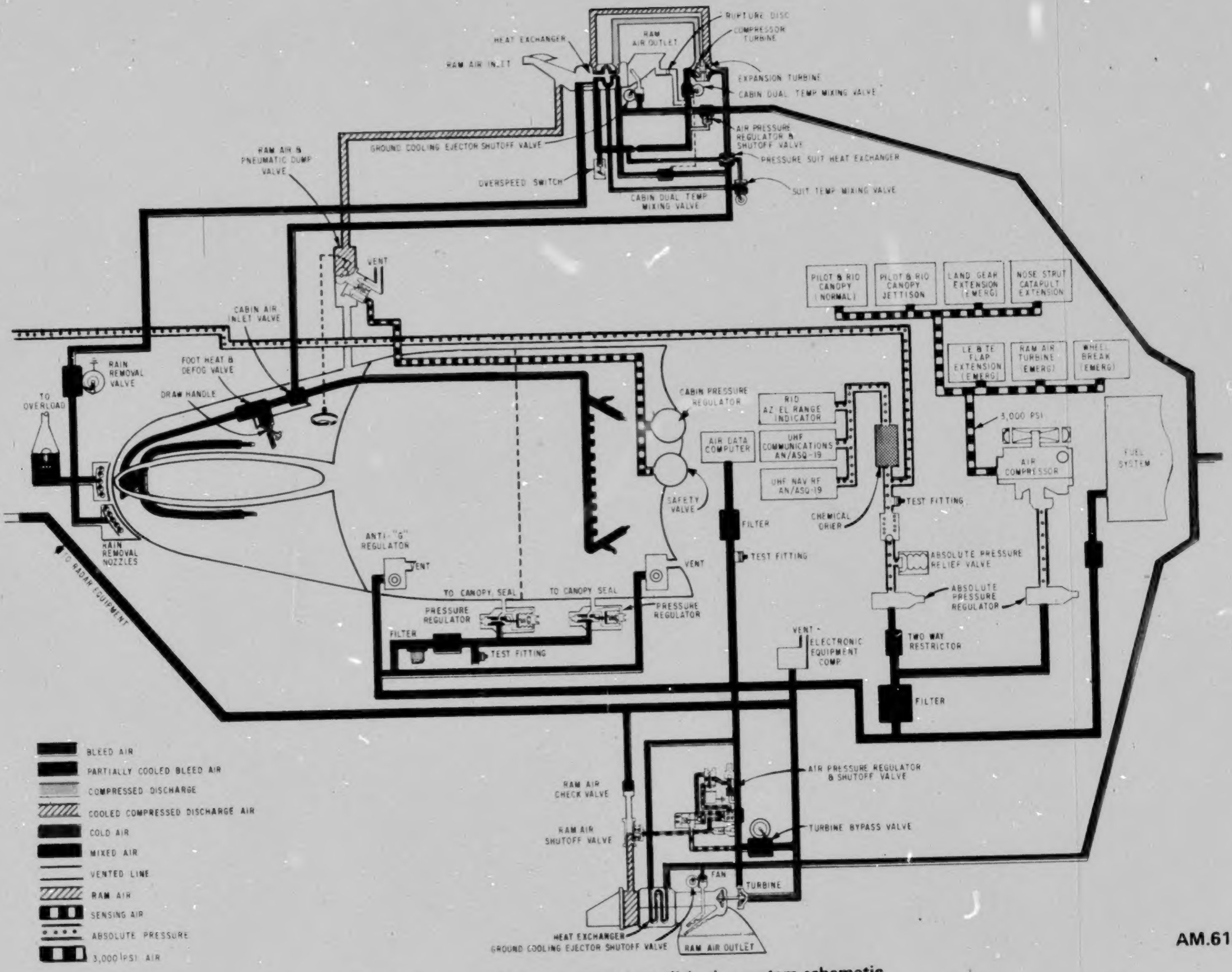
A cabin pressure regulator, indicator, safety valve, and ram air and pneumatic dump valve are included in the pressurization system. The system is also the source of air for the rain removal system, and emergency ventilation may be obtained by directing ram air into the cabin should the air-conditioning and pressurization system fail.

SYSTEM OPERATION

This description of the operation of an air-conditioning and pressurization system is intended to provide an understanding of the manner in which the system functions and the various components and subassemblies are employed. Figure 7-1 is a schematic diagram of a pressurization and air-conditioning system. Frequent reference to the schematic should be made during study of the following operational description.

High temperature and high pressure air from the bleed air system enters the cabin refrigeration unit through the bleed air pressure regulator and shutoff valve to the primary section of the heat exchanger and flows through one section of the cabin dual temperature mixing valve to the compressor turbine. The turbine compresses the air to raise its temperature and pressure for greater cooling efficiency when it passes through the secondary section of the heat exchanger.

The cooled air, flowing from the secondary section of the heat exchanger, passes through the turbine assembly again where it expands and is further cooled and ducted through the pressure suit heat exchanger to the cabin air inlet valve. The expansion of the air through the expansion turbine provides the energy to drive the compressor turbine.


RAM AIR OUTLET
RUPTURE DISC
COMPRESSOR TURBINE
HEAT EXCHANGER
RAM AIR INLET
EXPANSION TURBINE
CABIN DUAL TEMP MIXING VALVE
AIR PRESSURE REGULATOR & SHUTOFF VALVE
PRESSURE SUIT HEAT EXCHANGER
SUIT TEMP MIXING VALVE
CABIN DUAL TEMP MIXING VALVE
GROUND COOLING EJECTOR SHUTOFF VALVE
OVERSPEED SWITCH
RAM AIR & PNEUMATIC DUMP VALVE
VENT
CABIN AIR INLET VALVE
RAIN REMOVAL VALVE
FOOT HEAT & DEFOG VALVE
DRAW HANDLE
TO OVERLOAD
RAIN REMOVAL NOZZLES
TO RADAR EQUIPMENT
PILOT & RIO CANOPY (NORMAL)
PILOT & RIO CANOPY JETTISON
LAND GEAR EXTENSION (EMERG)
NOSE STRUT CATAPULT EXTENSION
LE & TE FLAP EXTENSION (EMERG)
RAM AIR TURBINE (EMERG)
WHEEL BREAK (EMERG)
3,000 PSI
AIR COMPRESSOR
FUEL SYSTEM
CABIN PRESSURE REGULATOR
SAFETY VALVE
RIO AZ EL RANGE INDICATOR
UHF COMMUNICATIONS AN/ASQ-19
UHF NAV RF AN/ASQ-19
AIR DATA COMPUTER
TEST FITTING
CHEMICAL DRIER
FILTER
TEST FITTING
ABSOLUTE PRESSURE RELIEF VALVE
ABSOLUTE PRESSURE REGULATOR
TWO WAY RESTRICTOR
FILTER
ANTI-"G" REGULATOR
VENT
VENT
TO CANOPY SEAL
TO CANOPY SEAL
PRESSURE REGULATOR
PRESSURE REGULATOR
FILTER
TEST FITTING
VENT - ELECTRONIC EQUIPMENT COMP.
AIR PRESSURE REGULATOR & SHUTOFF VALVE
TURBINE BYPASS VALVE
RAM AIR CHECK VALVE
RAM AIR SHUTOFF VALVE
FAN
TURBINE
HEAT EXCHANGER
GROUND COOLING EJECTOR SHUTOFF VALVE
RAM AIR OUTLET
BLEED AIR
PARTIALLY COOLED BLEED AIR
COMPRESSED DISCHARGE
COOLED COMPRESSED DISCHARGE AIR
COLD AIR
MIXED AIR
VENTED LINE
RAM AIR
SENSING AIR
ABSOLUTE PRESSURE
3,000 PSI AIR

AM.613

Figure 7-1.—Pressurization and air-conditioning system schematic.

At the same time, hot bleed air passes through the other section of the cabin dual temperature mixing valve, downstream of the pressure regulator and shutoff valve, and mixes with the cold air from the expansion turbine. The air then enters the cabin air inlet valve and flows aft to the heat diffusers and ventilators and forward to the foot heat defog valve and forward cockpit diffusers where it is distributed evenly throughout the spaces to provide comfort.

A rupture disc installed in the duct, upstream of the compressor turbine, will rupture with an over pressure condition, and a limiting venturi limits airflow out of the rupture disc so that other bleed air systems will not be affected because of the system air blowing overboard.

Cabin air pressure is automatically controlled by the cabin pressure regulator. It uses the same air that temperature conditions the cabin and operates on the principle that the cabin air-conditioning system supplies more air than is needed to maintain the cabin at a specific pressure, thus, the regulator opens to port excess air overboard.

The regulator has three ranges of operation—unpressurized, isobaric, and differential. Below 8,000 feet it maintains the cabin at ambient pressure. This is known as unpressurized operation. Between 8,000 feet and 23,100 feet, the cabin remains at an 8,000-foot pressure altitude due to the regulator operation in the isobaric range. The differential range of the regulator comes into operation above 23,100 feet by maintaining the cabin pressure at a 5-psi differential above ambient pressure. In this range, the regulator is actuated by the differential pressure existing between the outside atmosphere and the cabin, and is completely automatic.

The cabin safety valve prevents cabin pressure from exceeding safe structural limits, positive or negative, if the cabin pressure regulator malfunctions.

Emergency ram air is provided to supply the cabin with ventilating air if the air-conditioning or pressurization system is inoperative or to rid the cabin area of smoke, foul odors, or fumes which might threaten the comfort, visibility, or safety of the crewmembers.

The air-conditioning system is controlled by the temperature control panel. The control panel consists of a magnetic amplifier temperature control circuit, an AUTO/MANUAL switch, and an automatic temperature control selector. The control panel acts in conjunction with the cabin temperature sensor to maintain the cabin inlet air temperature as determined by the position of the automatic temperature control selector or the last manually selected temperature.

The cabin temperature sensor reflect a change in resistance with any temperature change and cause an immediate imbalance in the magnetic amplifier, which acts as a switch, and completes a circuit to operate the cabin temperature mixing valve.

The AUTO/MANUAL switch has four positions: AUTO, HOT, COLD, and OFF. When in AUTO and the temperature control selector is set at a desired temperature, the cabin dual temperature mixing valve will maintain the selected temperature. If the automatic system fails, the AUTO/MANUAL switch should be put in OFF, and the temperature will remain at the last selected temperature. Bumping the HOT or COLD position on the switch will activate the cabin dual temperature mixing valve to deliver hot or cold air as desired.

The emergency vent control, when in the down position, allows the cabin to be pressurized. When it is pulled out, it will dump cabin pressurization and allow ram air to enter the cabin for ventilation.

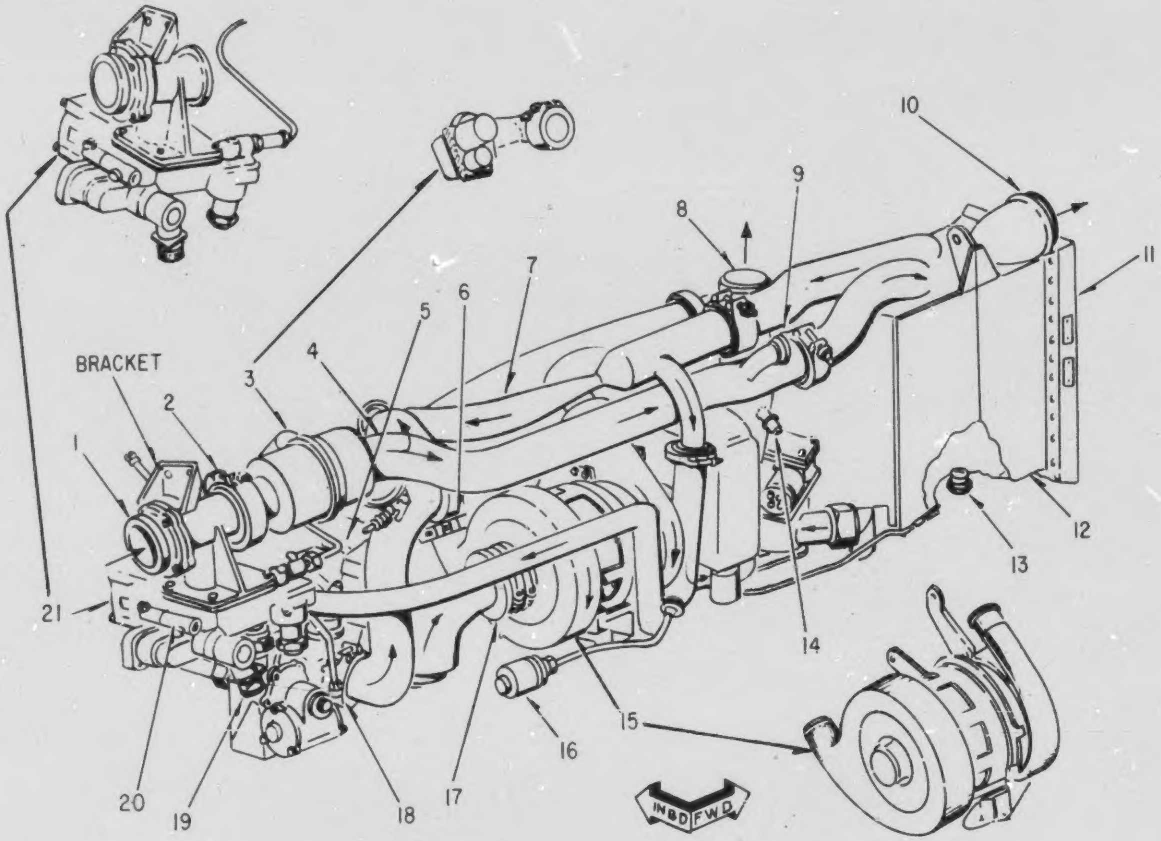
COMPONENT OPERATION

During the discussion of component operation, frequent reference to figure 7-2, cabin refrigeration unit, will help you to understand the interrelationship of some of the components as well as how and where they are located on the refrigeration unit.

Heat Exchanger

The heat exchanger is the largest component of the refrigeration unit and includes a core assembly, ram air inlet duct and flange, cooling air outlet duct, an ejector assembly, and a rupture disc in the ram air outlet duct.

The core assembly is composed of fins and tubes and is divided into two sections, the primary or hot air section and the secondary



AM.614

1. Engine bleed air inlet.
2. Janitrol coupling.
3. Ground cooling ejector shutoff valve.
4. Tolerance compensator duct.
5. Regulated pressure sensing line.
6. Marman coupling and seal.
7. Flow limiting venturi.
8. Cabin air outlet duct.
9. Rain removal bypass duct.
10. Rain removal air inlet duct.
11. Ram air inlet.
12. Cabin heat exchanger.
13. Heat exchanger drain valve.
14. Cabin manual temperature limiter.
15. Cooling turbine.
16. Turbine overspeed pressure switch.
17. Rubber coupling and seal.
18. Sensing line.
19. Bleed air pressure regulator and shutoff valve solenoid.
20. Bleed air pressure regulator and shutoff valve filter.
21. Bleed air pressure regulator and shutoff valve.

Figure 7-2.—Cabin refrigeration unit.

compressor discharge section. The primary section directs hot engine bleed air through the tubes for initial cooling. The secondary section directs cooling turbine compressor discharge air through the tubes for additional cooling before entering the expansion turbine.

Cooling Turbine

The cooling turbine consists of a compressor turbine scroll, bearing support housing and oil sump, expansion turbine scroll, and a compressor turbine and expansion turbine mounted on a common shaft inside bearings fitted to the shaft and bearing support housing. The compressor turbine is an outward flow radial impeller, and the expansion turbine is an inward flow radial impeller.

Air partially cooled by the heat exchanger enters the compressor turbine nozzle. The compressor turbine being driven at a high speed by the expansion turbine, compresses the partially cooled air, raising the temperature and pressure, thus allowing for greater cooling efficiency when it passes through the secondary heat exchanger. Cooled air from the secondary heat exchanger enters the expansion turbine for further cooling. Energy absorbed by the compressor turbine controls the speed of the expansion turbine.

Bleed Air Pressure Regulator and Shutoff Valve

The bleed air pressure regulator and shutoff valve (fig. 7-3) controls bleed air to the refrigeration unit as follows: The butterfly valve (12) controls bleed air to the refrigeration unit. Bleed control air is taken upstream of the butterfly valve and directed through the filter (9), metering valve (8), and switcher valve (7) to the pneumatic actuator. When solenoid (6) is deenergized, pressure is directed to actuator chamber (11), where it assists the spring and closes the valve. When the solenoid is energized, pressure is directed to the actuator opening chamber, overcomes the spring, and opens the valve.

Bleed air sensing pressure, sensed downstream of the heat exchanger, is directed to the high pressure differentiator assembly (5) to control the actuating pressure. A regulated pressure of 62 (±5) psig 8 is maintained at the cooling turbine compressor inlet.

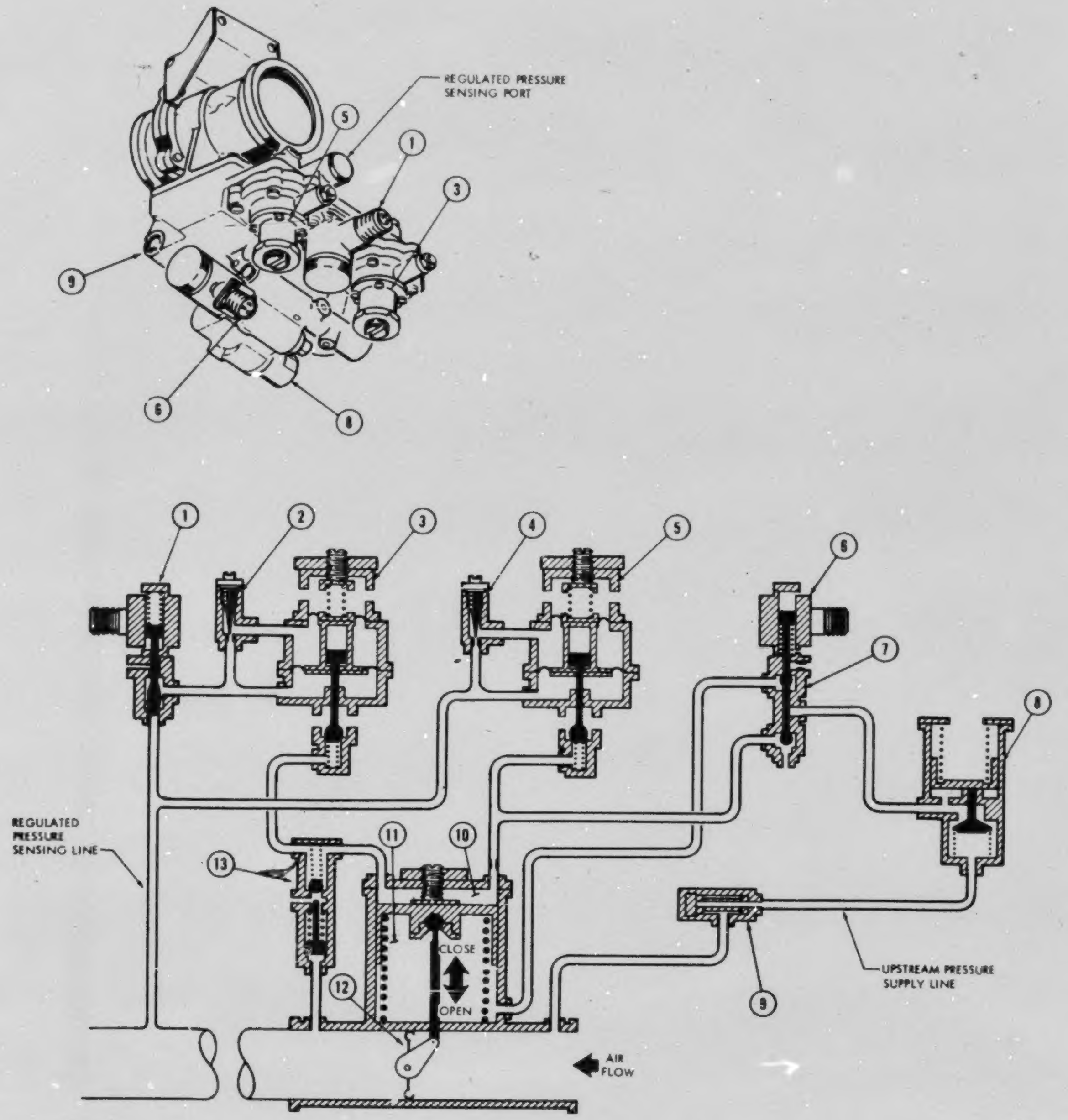
During operation of the rain removal system, the low pressure solenoid valve (1) is energized, permitting bleed air sensing pressure to the low pressure differentiator (3) to control the actuator pressure and position the butterfly valve to establish a regulated pressure of 40 (±5) psi to the cooling turbine compressor. Should regulator malfunction and bleed air pressure exceed allowable limits the rupture disc will break, allowing the excessive bleed air to discharge overboard through the ram air exit. This increase in pressure also causes the turbine overspeed pressure switch to actuate the cabin turbine overspeed warning light in the cockpit.

Cabin Dual Temperature Mixing Valve

The cabin dual temperature mixing valve performs the functions of controlling the direction of air flow at the compressor turbine inlet and maintaining desired cabin temperature. These functions are accomplished by a dual butterfly valve system which obstructs the airflow to the compressor turbine and by another butterfly valve which controls the amount of hot air mixing with cold expansion turbine outlet air. The temperature control panel controls the temperature of the air flowing to the cockpit through the mixing value.

The valve consists of a housing having two sections, each containing a butterfly valve and a electromechanical rotary actuator mounted on the cold port of the housing. The butterfly valves are linked together and positioned so that when one is open the other is closed. The actuator consists of an electric motor equipped with a magnetic friction brake, a gear train, two limit switches, radio noise suppressors, and a linkage assembly connecting the butterfly shafts.

A butterfly position indicator is mounted on the actuator assembly and driven by the output shaft. Modulation of the value is obtained by the interruption of current from the temperature control panel which operates the motor. The magnetic friction brake prevents coasting, and in conjunction with the gear train, holds the


REGULATED PRESSURE SENSING PORT
5
1
3
9
6
8
1
2
3
4
5
6
7
8
REGULATED PRESSURE SENSING LINE
13
11
10
CLOSE
OPEN
12
9
UPSTREAM PRESSURE SUPPLY LINE
AIR FLOW

AM.615

1. Low pressure solenoid valve.
2. Variable orifice.
3. Low pressure differentiator.
4. Variable orifice.
5. High pressure differentiator.
6. Switcher valve solenoid.
7. Switcher valve.
8. Metering valve.
9. Filter.
10. Actuator opening chamber.
11. Actuator closing chamber.
12. Butterfly.
13. Over pressure limiter.

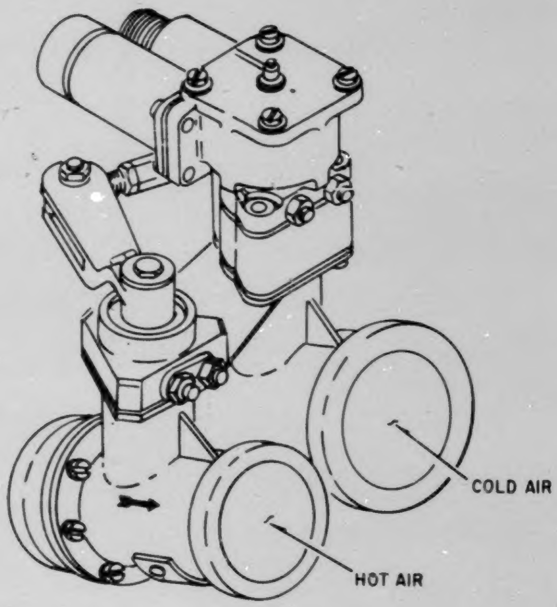
Figure 7-3.—Bleed air pressure regulator and shutoff valve schematic.

butterflies in the position desired. Figure 7-4 shows the cabin dual temperature mixing valve.

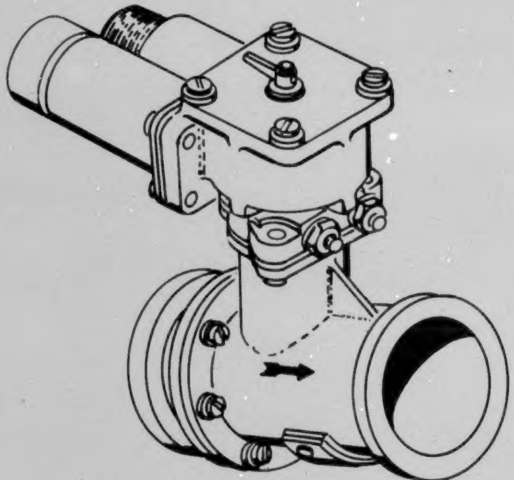
Ground Cooling Ejector Shutoff Valve

The ground cooling ejector shutoff valve controls the engine bleed air discharge through the ejector assembly, located in the cooling air outlet duct. Action of the engine bleed air discharged through the ejector assembly augments cooling-air flow through the heat exchanger and connecting ducts during ground operation. The unit consists of two assemblies–an electromechanical rotary actuator and a butterfly valve assembly.

The actuator is mounted on the valve assembly and contains an electric motor which is equipped with a magnetic brake, a gear train, two limit switches, and an output shaft. The butterfly valve assembly consists of a valve, housing, and a bearing-mounted valve shaft. The bearing mounted valve shaft is connected to the actuator through the gear train, which operates a valve position indicator on top of the actuator housing. Figure 7-5 shows a ground cooling ejector shutoff valve.



AM.616
Figure 7-4.–Cabin dual temperature mixing valve.



AM.617
Figure 7-5.–Ground cooling ejector shutoff valve.

Cabin Temperature Sensor

The cabin temperature sensor consists of a negative temperature coefficient resistance sensitive thermistor, mounted in a housing and located in the cabin air inlet valve. A change in sensor resistance due to changes in temperature is detected by the temperature control panel and results in operation of the electrical components of the cabin/refrigeration unit. Signals from the sensor indicate changes in temperature within the duct.

Cabin Manual Temperature Limiter

The cabin manual temperature limiter is a normally closed switch consisting of a temperature sensitive element, electrical contacts, and housing. The function of the switch is to limit maximum temperature within the duct by breaking the electrical circuit to the cabin dual temperature mixing valve when using manual temperature control.

Temperature Control Panel

The temperature control panel controls the temperature of the air entering the cabin by controlling the operation of the cabin temperature mixing valve. The control panel acts with the cabin temperature sensor to maintain the cabin inlet air temperature as determined by the position of the automatic temperature control selector or the last manually selected temperature.

The pilot is required to readjust the cabin temperature as the aircraft makes a major change in altitude or velocity. Heat conduction through the canopy and cabin walls changes cabin temperature but does not affect the temperature sensor in the cabin inlet air duct. Insulation of the cabin walls retards this heat transfer and gives the pilot ample time to make adjustments. Figure 7-6 shows system controls.

Cabin Pressure Regulator

The cabin pressure regulator, located in the aft cockpit, is pneumatically controlled and regulates cabin pressure by controlling the outflow of air from the cabin. The cabin pressure regulator serves as a dump valve along with the safety valve when the EMERG VENT control is pulled. The atmosphere port is vented to the atmosphere and the auxiliary port is interconnected with the cabin safety valve in the emergency air inlet valve. The ground test valve on the regulator head, when placed in TEST ONLY - ALL OFF position, will render the regulator inoperative.

CAUTION: The test valve must be safetied with lockwire in the FLIGHT position at all times other than ground operational checks.

Cabin air enters the reference chamber of the regulator through the air orifice and filter to establish a reference pressure. The balance portion of the outflow valve diaphragm pneumatically balances the outflow valve, thus the valve opens or closes as reference pressure on the outflow valve cover plate increases or decreases through various modes of operation.

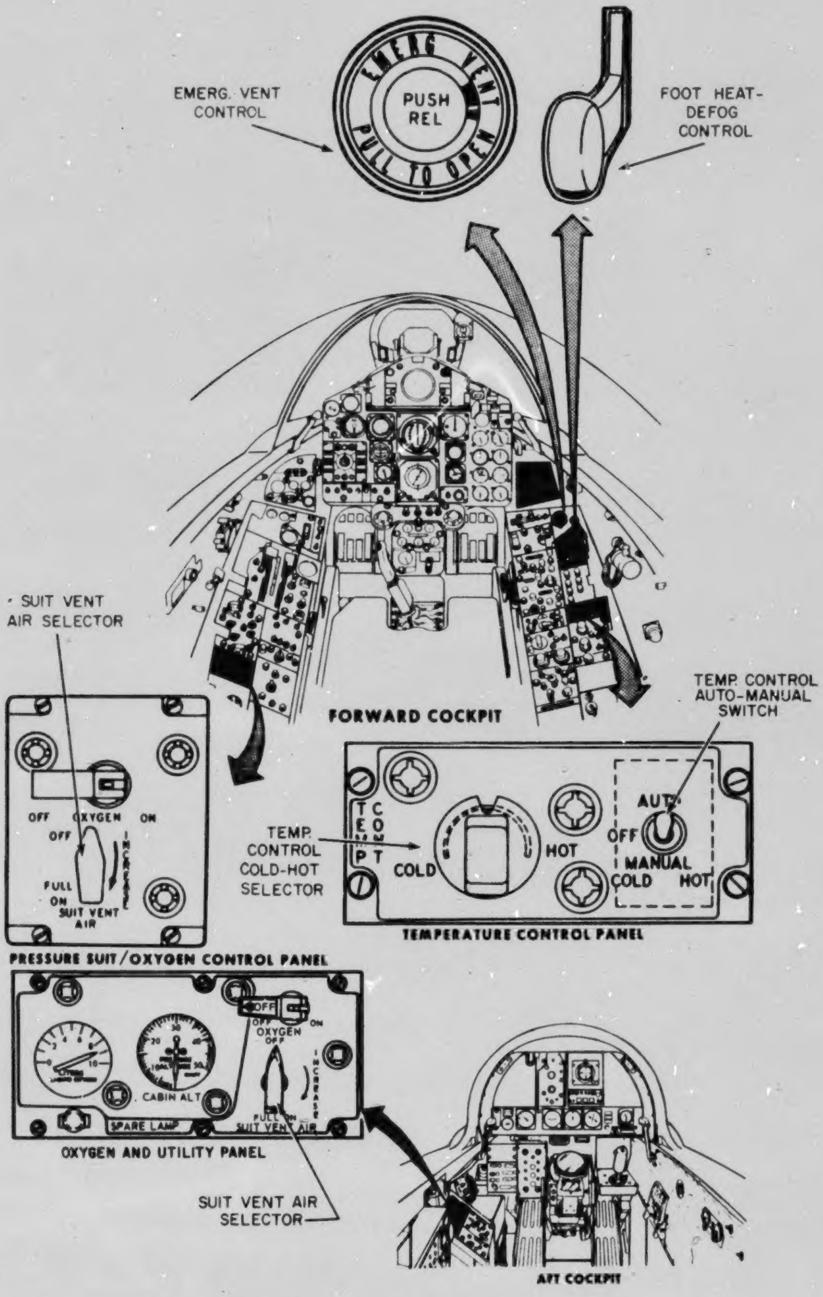
By regulating reference chamber air pressure, the isobaric and differential control systems control the actions of the outflow valve to provide the three modes of operation called unpressurized, isobaric, and differential. Figure 7-7 shows the regulator in the three modes of operation.

During the unpressurized range of operation, reference chamber pressure is sufficient to compress the isobaric bellows and move the metering valve to the open position. Cabin air entering the reference chamber through the cabin air orifice is then allowed to flow to atmosphere through the isobaric metering valve. Since the cabin air orifice is smaller than the orifice formed by the metering valve, reference chamber pressure remains approximately the same as atmospheric pressure. As a result, the pressure differential across the outflow valve is sufficient to open the valve and dump cabin air.

As the isobaric range is approached (8,000-ft altitude), reference chamber pressure (which has been decreasing at the same rate as atmospheric pressure) will have decreased enough to allow the isobaric bellows to expand and move the metering valve toward its seat. As a result, the flow of reference chamber air through the metering valve is reduced, preventing further decrease in reference pressure.

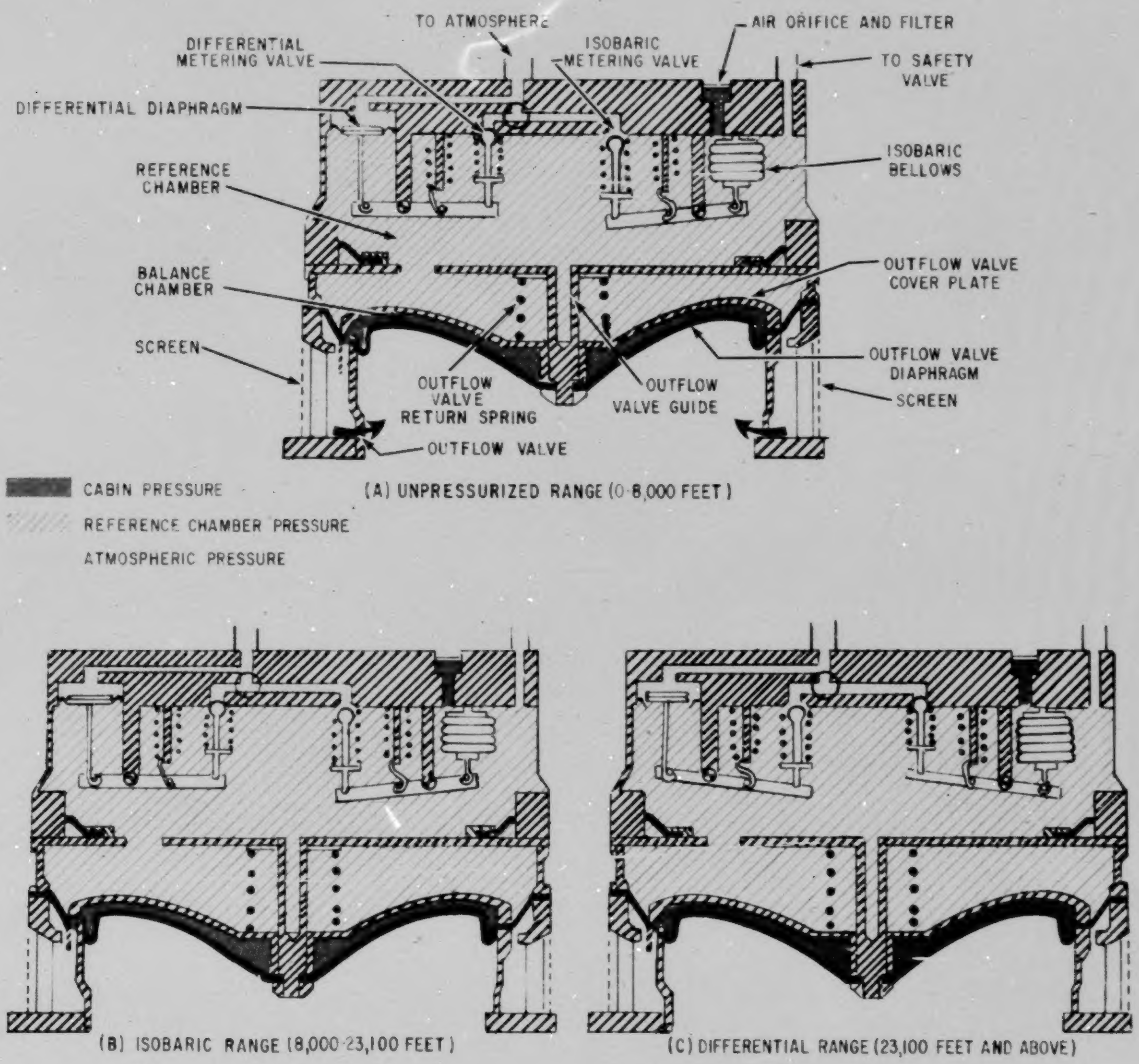
The isobaric control system modulates (in response to flight changes in reference chamber pressure) to maintain a substantially constant reference pressure in the chamber throughout the isobaric range of operation. The outflow valve (responding to the differential between the constant reference chamber pressure and the variable cabin pressure) opens or closes, metering air from the cabin, as required, to maintain a constant cabin pressure.

As the differential range is approached (23,100 ft), the pressure differential between the constant reference pressure and the decreasing atmospheric pressure becomes sufficient to move the diaphragm and open the differential metering valve. As a result, reference chamber air flows to atmosphere through the differential metering valve, reducing the reference pressure. The isobaric bellows (responding to the decreased


EMERG. VENT CONTROL
EMERG VENT
PUSH REL
PULL TO OPEN
FOOT HEAT-DEFOG CONTROL
SUIT VENT AIR SELECTOR
FORWARD COCKPIT
TEMP. CONTROL AUTO-MANUAL SWITCH
OFF
OXYGEN
ON
FULL ON
SUIT VENT AIR
INCREASE
PRESSURE SUIT/OXYGEN CONTROL PANEL
TEMP. CONTROL COLD-HOT SELECTOR
TEMP COMP
COLD
HOT
AUTO
MANUAL
TEMPERATURE CONTROL PANEL
CABIN ALT
SPARE LAMP
OXYGEN AND UTILITY PANEL
SUIT VENT AIR SELECTOR
AFT COCKPIT

AM.619

Figure 7-6.–System controls.


TO ATMOSPHERE
DIFFERENTIAL METERING VALVE
ISOBARIC METERING VALVE
AIR ORIFICE AND FILTER
TO SAFETY VALVE
DIFFERENTIAL DIAPHRAGM
ISOBARIC BELLOWS
REFERENCE CHAMBER
BALANCE CHAMBER
OUTFLOW VALVE COVER PLATE
SCREEN
OUTFLOW VALVE DIAPHRAGM
OUTFLOW VALVE RETURN SPRING
OUTFLOW VALVE GUIDE
SCREEN
OUTFLOW VALVE
CABIN PRESSURE
REFERENCE CHAMBER PRESSURE
ATMOSPHERIC PRESSURE

(A) UNPRESSURIZED RANGE (0-8,000 FEET)

(B) ISOBARIC RANGE (8,000-23,100 FEET)

(C) DIFFERENTIAL RANGE (23,100 FEET AND ABOVE)

AM.620

Figure 7-7.—Cabin pressure regulator; (A) unpressurized range (0-8,000 ft), (B) isobaric range (8,000-23,100 ft); (C) differential range (23,100 ft and above).

reference pressure) expands and closes the isobaric metering valve completely.

Reference chamber pressure is now controlled, through the differential metering valve, by atmospheric pressure being reflected against the differential diaphragm. As atmospheric pressure decreases, the metering valve opens more and allows reference pressure to decrease proportionately. The outflow valve (responding to the pressure differential between cabin and reference pressures) opens or closes, as required, to meter air from the cabin and maintains a 5 psi differential.

Cabin Pressure Indicator

The cabin pressure indicator, located in each cockpit, provides visual indication of the cabin pressure in terms of altitude ranging from 0 to 50,000 feet.

Cabin Pressure Safety Valve

The cabin pressure safety valve, located beside the cabin pressure regulator, is a safety device for combined pressure relief. Its three functions are as follows:

1. Excessive cabin pressure relief. The safety valve prevents differential pressure between cabin and atmosphere from exceeding 5.5 psi. When the cabin pressure regulator malfunctions and a pressure differential of 5.25 psi is reached the safety valve automatically cracks to relieve cabin air.
2. Negative pressure relief. During a rapid rate descent from altitude the safety valve allows air to enter the cabin from the oxygen compartment. This occurs when the compartment pressure (atmospheric pressure) exceeds the cabin pressure by a differential pressure of 10 inches of water.
3. Dumps cabin air. Upon pulling the EMERG VENT control, the incoming engine bleed air is shut off at the cabin refrigeration unit bleed air pressure regulator and shutoff valve. The cabin pressure regulator and safety valve simultaneously vent open through the pneumatic dump valve, dumping cabin air within 5 seconds.

Ram Air and Pneumatic Dump Valve

The ram air and pneumatic dump valve is manually controlled by the EMERG VENT control. Pulling the control causes ram air to the refrigeration unit to be diverted into the cabin.

The valve consists of a housing, butterfly, cam, microswitch, and dump valve. The butterfly has an O-ring around the edge to insure positive sealing of the cabin when the valve is closed. The cam deactuates the microswitch, breaking the electrical circuit to the bleed air pressure regulator and shutoff valve, thus shutting down the refrigeration unit. The same cam also actuates the dump valve, which vents the cabin pressure regulator and safety valve reference chambers to atmosphere, thus dumping cabin pressure.

The ram air and pneumatic dump valve is shown in figure 7-8.

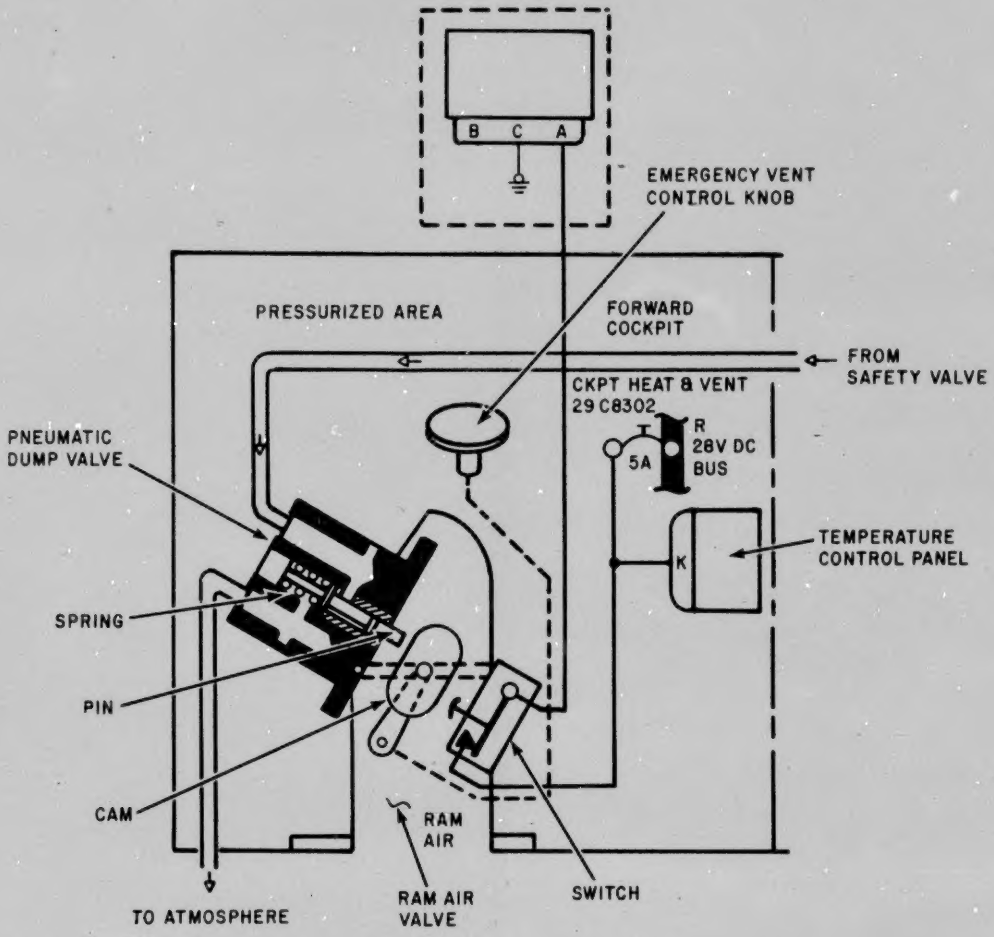
MAINTENANCE

General maintenance performed on cabin air-conditioning and pressurization systems includes visual and operational inspections, minor rigging, servicing, and removal and replacement of system components, as well as troubleshooting. AME's must demonstrate the ability to analyze system malfunctions, isolate defective components, determine corrective action, and replace defective components prior to advancement to AME1.

Servicing

Servicing for the F-4 cabin air-conditioning and pressurization system is limited to periodic inspections for visible defects and dirt or other foreign material accumulation. Particular attention should be paid for structural failure, scoring, galling, rust, and corrosion, and all parts failing to meet inspection requirements must be replaced. All major components of the system are self-sustaining and require no general servicing between overhaul periods for normal operation.

On other types of aircraft, the turbine refrigeration unit is checked on each preflight and daily inspection for proper servicing.


B
C
A
EMERGENCY VENT CONTROL KNOB
PRESSURIZED AREA
FORWARD COCKPIT
FROM SAFETY VALVE
CKPT HEAT & VENT 29 C8302
R
28V DC BUS
5A
PNEUMATIC DUMP VALVE
TEMPERATURE CONTROL PANEL
K
SPRING
PIN
CAM
RAM AIR
TO ATMOSPHERE
RAM AIR VALVE
SWITCH

AM.621

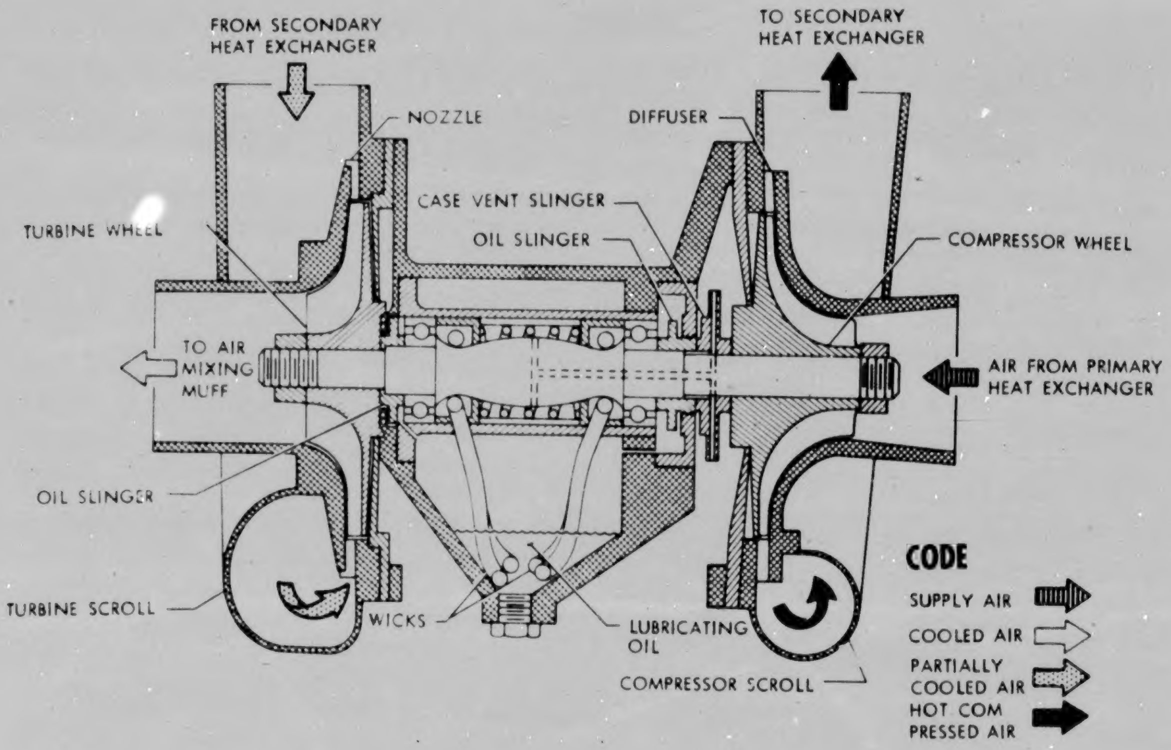
Figure 7-8.—Ram air pneumatic dump valve.

Some turbine refrigeration unit rotating assembly bearings are lubricated by an air-oil mist. Oil absorbed by the wick from the oil sump, illustrated in figure 7-9 is distributed on the rotating assembly shaft as a result of capillary action of the wick. Rotation of the shaft causes the oil to diffuse into an air-oil mist. Action of the oil slingers cause this air-oil mist to pass through the bearings, effecting bearing lubrication. The oil then returns to the sump.

The AME servicing the unit inspects one of the two sight gages provided on the turbine unit for the correct level of lubricating oil. If the fluid level is below one-fourth of the visible area of the sight gage, the applicable lubricating oil must be added. Figure 7-10 shows a turbine unit sight gage and filler plug.

Replacement of Components

Replacement procedures are found in all aircraft Maintenance Instruction Manuals. These procedures normally include information such as the tools and equipment list, material list,


FROM SECONDARY HEAT EXCHANGER
TO SECONDARY HEAT EXCHANGER
NOZZLE
DIFFUSER
CASE VENT SLINGER
OIL SLINGER
TURBINE WHEEL
COMPRESSOR WHEEL
TO AIR MIXING MUFF
AIR FROM PRIMARY HEAT EXCHANGER
OIL SLINGER
TURBINE SCROLL
WICKS
LUBRICATING OIL
COMPRESSOR SCROLL
CODE
SUPPLY AIR
COOLED AIR
PARTIALLY COOLED AIR
HOT COMPRESSED AIR

AM.622

Figure 7-9.–Full view of a turbine refrigeration unit.

manpower requirements, and step-by-step maintenance procedures. This information aids the work center supervisor in assigning and planning maintenance tasks.

When installing components such as turbines and mixing and shutoff valves, the AME must observe several general installation rules. These rules must be followed to insure efficient and safe operation of the system. A few of these installation rules are as follows:

1. Use the proper tools for the task at hand.

2. Cap or plug all open lines and ports during removal and replacement of components.

3. Install new O-rings when required on fittings as specified in the applicable Maintenance Instructions Manual.

4. Insure that all duct mounting flanges and gaskets are not damaged and are free from dirt and foreign matter.

NOTE: No repairs of any description on duct connectors are allowed. If a duct connector is damaged, it must be replaced.

5. Inspect connecting ducting for damage; any ducting having dents that restrict more than one-fifth of the volume must be replaced or repaired.

6. Insulation blankets are inspected for damage. Repairs of blankets are normally restricted to minor holes or cracks repairable by patching. If damage is extensive, a complete section is replaced. Metal foil type blankets cannot be repaired.

7. Insure that all Marman clamp mounting, bolts, and tube fittings have been torqued to

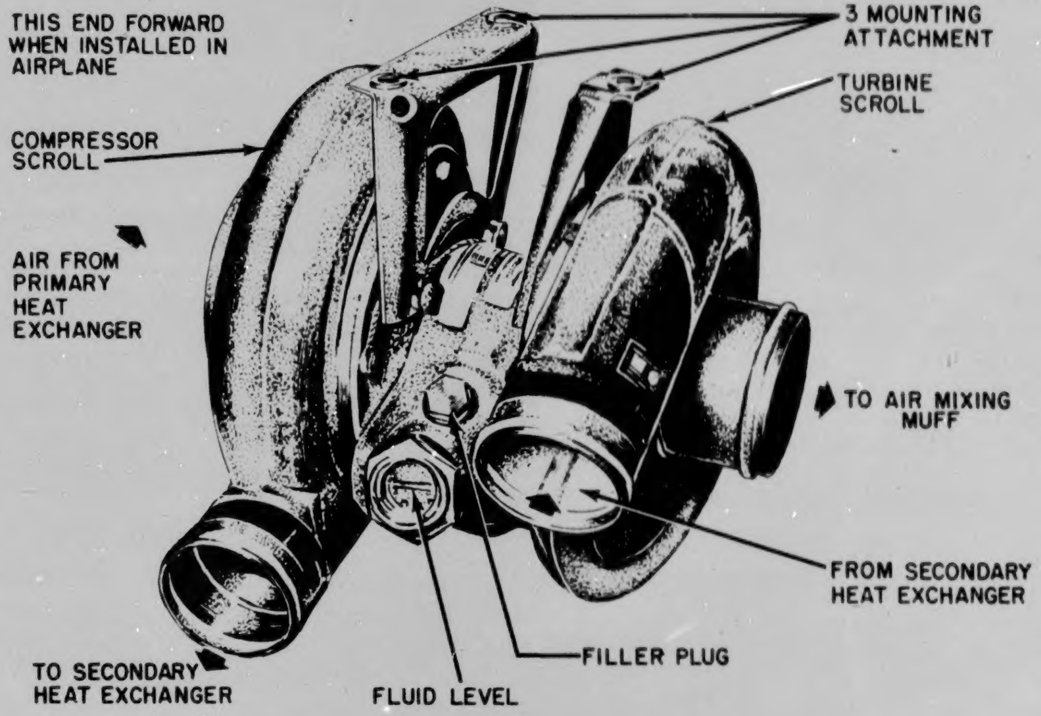

THIS END FORWARD WHEN INSTALLED IN AIRPLANE
3 MOUNTING ATTACHMENT
TURBINE SCROLL
COMPRESSOR SCROLL
AIR FROM PRIMARY HEAT EXCHANGER
TO AIR MIXING MUFF
FROM SECONDARY HEAT EXCHANGER
FILLER PLUG
TO SECONDARY HEAT EXCHANGER
FLUID LEVEL
AM.623

Figure 7-10.—Turbine unit showing sight gage.

the amount specified in the applicable Maintenance Instructions Manual.

NOTE: Marman clamps are normally retorqued after the system has been heated to operating temperature.

8. Inspect installation for correct safetying of hardward-lockwiring, cotter pins, etc.

9. Prior to removing and installing cannon plugs and other electrical devices, insure that electrical power is OFF.

10. Inspect cannon plugs for broken or bent pins and stripped threads, as well as for corrosion.

11. Insure that bonding wires and shock mounts are installed during replacement of components.

12. After completion of component replacement, perform an operational check of the system.

NOTE: The operational check consists of a minimum of five complete cycles.

Operational Checking

There are two operational type checks that can be performed by AME's on the cabin air-conditioning and pressurization system. The first is a general operational check of the complete system, designed to insure the proper operation of each major system component as well as the complete system. The second is a cabin pressurization check, designed to test the cabin for airtightness as required.

The cabin air-conditioning system may be operationally tested to prove its mechanical integrity and temperature control response by using the procedures outlined in the applicable Maintenance Instructions Manual. Bear in mind that all aircraft systems vary from one aircraft to another, and for this reason the appropriate manual should always be used and the step-by-step procedures followed.

Troubleshooting

Troubleshooting and the use of troubleshooting charts are covered in other chapters of this manual and, since the Maintenance Instructions Manual for the F-4 air-conditioning and pressurization system uses the TROUBLE ANALYSIS method for correcting discrepancies and malfunctions, some examples of this method are used in this chapter.

Trouble Analysis.

Trouble analysis is a highly efficient method in which maintenance personnel are provided with a means to logically pursue a trouble to a satisfactory solution by the process of elimination. The symptom is defined in tabular form with a remedy for each symptom in tables 7-1 and 7-2.

Table 7-1 relates to checkout procedures by direct reference and table 7-2 relates to discrepancies occurring in an operational environment (in-flight or ground operation). Each table provides a remedy for each symptom. When the remedy is as simple as replacing a component or making an adjustment, this will be so stated. When the remedy requires further analysis, the entry in the REMEDY column will be a reference to an applicable paragraph or figure in the aircraft Maintenance Instructions Manual, or to some other manual.

Each trouble analysis procedure provides preliminary data, such as tools and equipment, manpower requirements, materials, etc. The procedure contains a NO-YES column to direct the technician through a logical series of steps to isolate the malfunction.

When the requirements of a step are satisfactory, refer to the YES column and perform the referenced step. When the requirements of a step are not satisfactory, refer to the NO column and perform the referenced step. This method is used until the malfunction is isolated and corrected. The original checkout procedure must be performed to insure the malfunction has been corrected. See table 7-3 for examples of Analysis procedures.

Since the air-conditioning and pressurization system has several electrically controlled components, trouble analysis and troubleshooting must also include the related electrical circuits in many instances. Although personnel of the AE rating will generally be assigned to assist the AME shop personnel in the correction of system discrepancies involving electrical components, the AME should be able to check circuits for loose connections, and even to perform continuity checks when necessary.

Loose connections are located by checking all connectors in the circuit. A connector that can be turned by hand is loose and should be tightened handtight.

A continuity check is simply a matter of determining whether or not the circuit to the electrically controlled unit is complete. The check for continuity may be made with a test lamp, which can be drawn from supply or made up in the shop.

To perform a continuity check, the connector at the electrically controlled unit is first disconnected. Then, with all necessary switches and circuit breakers closed, the test lamp is connected into the circuit at the electrical connector. The lamp thus indicates whether or not the circuit is complete.

Continuity checks may also be made with the use of the multimeter. A multimeter is an instrument used for measuring resistance, voltage, or amperage. Using this instrument is primarily the responsibility of the AE; however, instructions pertaining to its use are contained in the basic training manual, Basic Electricity, NavPers 10086-B (ch. 15). Certain portions of Basic Electricity are recommended supplemental reading for all AME personnel.

VAPOR CYCLE SYSTEM

A vapor cycle air-conditioning system provides greater cooling capacity than normally accomplished by other air cycle systems. The

Table 7-1.—Example of checkout procedure trouble analysis (from F-4 MIM).

REFERENCE	SYMPTOM	REMEDY
System Checkout Figure 4-14	Smoke in cockpit and one or more system circuit breakers popped in aft cockpit.	Refer to Paragraph 4-66.
Step 4	No change in temperature when Foot Heat-Defog control is positioned from FOOT HEAT to DEFOG.	Refer to Paragraph 4-69.
Step 4	Insufficient defogging of windshield-center panel.	Nozzle improperly installed. Feel for direction of airflow and reposition defog nozzle properly.
Step 4	Temperature control selector must be near full HOT to operate in AUTO.	Replace TEMP CONT panel.
Step 5	Insufficient hot air to feet.	Relocate wire bundles, clamps, etc., to clear foot heat-defog control linkage or re-rig air distribution valves.
Step 6	Intermittent operation of temperature control in AUTO or MANUAL.	Tighten loose electrical connector on cabin dual temperature mixing valve or replace valve.
Step 6	High pitch squeal which disappears when EMERG VENT control is pulled.	Replace cooling turbine.
Step 8	Insufficient or no heat with AUTO/MANUAL switch in AUTO, operates normal in MANUAL.	Perform Refrigeration Unit Checkout. If test was satisfactory, replace TEMP CONT panel. If test was not satisfactory, replace cabin temperature sensor.
Steps 18 and 19	Airflow and cabin noise level fails to decrease or increase when rain removal switch is engaged or disengaged.	Refer to Paragraph 4-72.

Table 7-2.—Example of flight symptom trouble analysis (from F-4 MIM).

SYMPTOM	REMEDY
CABIN TURB OVERSPEED light flickers while pressurizing, goes out when pressurization stabilizes.	Refer to Paragraph 4-76 (table 7-3).
CABIN TURB OVERSPEED light flickers while EMERG VENT control is pushed down or when throties are advanced rapidly.	Refer to Paragraph 4-84 (table 7-3).

Table 7-3.—Example of analysis procedure, sheet 1 (from F-4 MIM).

4-76. CABIN TURB OVERSPEED LIGHT FLICKERS WHILE PRESSURIZING. GOES OUT WHEN PRESSURIZATION STABILIZES.

4-77. Tools and Equipment.

External Electrical Power Source	(1, Figure 2-2)
Gage	(18, Figure 2-2)
Torque Wrench	(15, Figure 2-2)

4-78. Manpower Requirements.

a. Two men required.

4-79. Procedure.

Note

If hydraulic pressure is not connected to aircraft, the aft nose landing gear door may be partially closed without disconnecting linkage.

WARNING

If hydraulic power is applied (with linkage connected) and door is partially closed, door will open rapidly and injury to personnel may result.

	NO	YES
a. Visually check for clogged drain hole in turbine overspeed pressure switch sensing line. Is drain hole clogged?	c	b
b. Clean sensing line.	-	-
c. On RF-4 aircraft, remove elbow duct connecting cooling turbine and cabin dual temperature mixing valve. Using strong light and long handle (small) mirror, check through valve for presence and condition of rupture disc. On F-4 aircraft, disconnect nose landing gear door linkage. Using strong light and long handle (small) mirror, check through second louver forward from aft end of ram air exit. Is rupture disc broken or missing?	e	d
d. Replace rupture disc.	-	-
e. Perform turbine overspeed pressure switch checkout. Did switch meet requirements of test?	f	g
f. Replace turbine overspeed pressure switch.	-	-
g. Disconnect turbine overspeed pressure switch sensing line at pressure suit heat exchanger and install gage.	-	-
h. Connect external electrical power to aircraft. Refer to NAVAIR 01-245FDB-2-1.1.	-	-
i. Start left engine. On F-4J 155903ap AND UP; ALSO F-4B, RF-4B, AND F-4J 153071z THRU 157273ao AFTER AFC 440, BLEED AIR switch must be in NORM. Refer to NAVAIR 01-245FDB-2-1.1.	-	-
j. With engine running at 80 to 95%, check gage for indication of 62 (± 5) psig. Was indication satisfactory?	k	-
k. Replace bleed air pressure regulator and shutoff valve.	-	-

4-84. CABIN TURB OVERSPEED LIGHT FLICKERS WHEN EMERG VENT CONTROL IS PUSHED DOWN OR WHEN THROTTLES ARE ADVANCED RAPIDLY.

4-85. Tools and Equipment.

Torque Wrench	(15, Figure 2-2)

4-86. Procedure.

	NO	YES
a. Check water drain hole in sensing line to turbine overspeed pressure switch. Hole is located in lowest part of line. Is hole clogged?	c	b
b. Clean clogged hole.	-	-
c. Check for loose sensing lines to bleed air pressure regulator and shutoff valve. Are lines loose?	e	d
d. Tighten lines.	-	-
e. On RF-4 aircraft, remove elbow duct connecting cooling turbine and cabin dual temperature mixing valve. Using strong light and long handle (small) mirror, check through valve for presence and condition of rupture disc.		

E-2A is one aircraft in the Navy using this type of installation. This installation uses this source of conditioned air to cool electronic equipment installed within the aircraft. The excess heat is removed by direct contact with the equipment being cooled, and this heat is transferred through the system's evaporator assembly.

Descriptive and operational material on the E-2A aircraft vapor cycle system can be found in Aviation Structural Mechanic E 3 & 2, NavTra 10309-C. The senior AME's are responsible for and are concerned with maintenance and troubleshooting of this system.

MAINTENANCE

Maintenance of the vapor cycle system includes replacement of components, charging the evaporator and condenser group assemblies, and troubleshooting.

Replacement of Components

Removing and installing components in the vapor cycle system is normally accomplished by AME3's and AME2's. However, senior petty officers of the AME rating must insure that a quality assurance program is in effect. Only qualified AME's perform quality assurance inspections. These inspections are performed during the maintenance task as well as at the completion of the maintenance task.

Since AME's remove units within a vapor cycle system, they must be familiar with the safety precautions concerning Freon to prevent injury to personnel and damage to equipment. A list of these safety precautions follows:

1. When handling Freon, protective equipment–apron, gloves, goggles, and face mask–must be worn.
2. If liquid Freon comes in contact with skin, treat the skin for frostbite.
3. If liquid Freon comes in contact with the eyes, call a doctor and use the following first aid treatment. Do not rub or irritate the eyes; drop sterile mineral oil into the eyes; then wash the eyes with a boric acid solution if the irritation continues.
4. Freon is stored in cylinders that are color coded orange for identification. These cylinders should be handled carefully because the pressure inside the cylinder depends upon the ambient temperature. Refrigerant cylinders should not be exposed to high temperatures or to flames. Containers that are used for high-pressure liquids should never be thrown around, dropped, or used for anything other than for their intended purpose.
5. Freon acts as a solvent when in contact with natural rubber. Never use substitutes for recommended gaskets or O-rings.

EVAPORATOR GROUP ASSEMBLY.–The evaporator group assembly is removed from the aircraft for servicing and replacement of components. This is accomplished by first insuring that aircraft power is OFF. Remove the header assembly ducting from the evaporator and the safety wire from the two mounting bolts. Then, the return quick- disconnect line, mounted at the top aft part of the unit, is detached. (See fig. 7-11). Next, the two electrical plugs, located on the top aft part of the unit, and the oil drain line are disconnected. Insert a No. 12 drill rod into the hub holes of the evaporator group assembly vibration mounts. Hold the drill rod to prevent rotation of the mounts while loosening the mountings bolts.

CAUTION: When removing the mounting bolts, physically support the evaporator group assembly to prevent it from sliding down the mounting rails. Do not lift or support the evaporator group assembly by means of the tube assemblies or individual components. Use the tubular frame for lifting or supporting the assembly.

With the bolts removed, permit the assembly to slide down its mounting rails only far enough to gain access to the four quick-disconnects at the top of the assembly. Hold the assembly securely in this position and disconnect the four quick-disconnects at the top of the assembly. The evaporator is then free from the aircraft.

The installation procedure is the reverse of the removal procedure with the addition of a quality assurance inspection.

CONDENSER GROUP ASSEMBLY.–The condenser group assembly is removed from the aircraft in accordance with the step-by-step procedure outlined in the aircraft Maintenance Instructions Manual. As in removal of the evaporator group assembly, the aircraft electrical power must be OFF. The necessary access panels

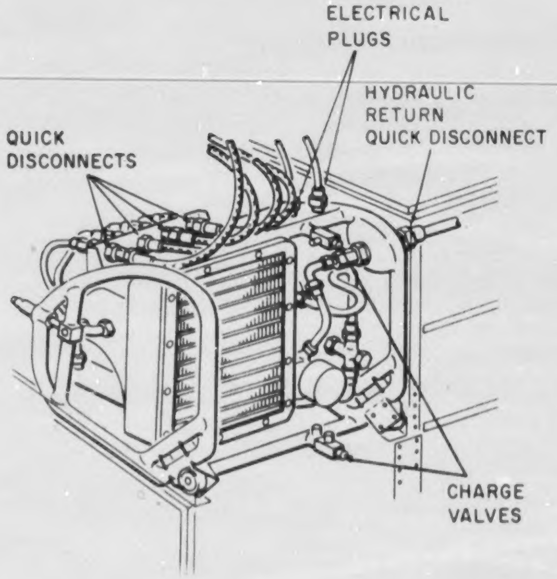


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Figure 7-11.—Evaporator group assembly.

and hydraulic heat exchanger are then removed. Disconnect the two refrigerant quick-disconnects on the evaporator group assembly. In addition, attach one end of a flexible hose to the condenser group assembly charge valve and place the other end in a container suitable for accepting Freon refrigerant. Open the charge valve and permit the refrigerant to drain from the condenser group assembly. After draining, the charge valve is closed and the drain hose is disconnected. Next, the liquid refrigerant and vapor refrigerant lines are disconnected from the assembly. After all mounting screws and bolts are removed from the assembly, the assembly is free to be removed from the aircraft through the top of the ram airscoop.

Installation of the condenser group assembly is the reverse of the removal procedure with the addition or replacement of necessary O-rings, performance of a pressure loss leak test, as well as charging the assembly.

Servicing

Servicing the vapor cycle system with Freon refrigerant is performed by personnel of the AME rating. The procedures for servicing the refrigeration system, the evaporator group, and the condenser group are similar. However, the mechanic performing the task must obtain the specific details from the applicable Maintenance Instructions Manual.

Troubleshooting

Troubleshooting the vapor cycle system is similar to troubleshooting other types of air-conditioning and pressurization systems. It is basically a step-by-step procedure used to detect discrepancies and eventually finding a remedy. This is performed by following the general troubleshooting steps mentioned previously in chapter 6 for troubleshooting.

It is very similar to the F-4's system trouble analysis but uses troubleshooting charts, furnished by the manufacturer, during its troubleshooting procedures.

CABIN LEAKAGE TEST EQUIPMENT

In order to test cabin pressurization systems satisfactorily, the AME must be able to operate cabin leakage test equipment. The tester is designed to supply air to aircraft cabin and/or canopy seals at controlled pressures for checking the cabin and/or canopy seals for safety and satisfactory performance. In the following paragraphs, the pressurized cabin leakage tester, PN 75481, manufactured by Sprague Engineering Corporation, Gardena, California, is discussed.

This tester, illustrated in figure 7-12, is a completely self-contained, portable unit consisting of a cabinet assembly, cart assembly, canopy pressurization system, cockpit leakage testing system, complete instrumentation, and an accessory kit comprised of hoses, adapter, hose clamps, and stethoscope. This tester can be used on most aircraft when the proper adaptors are obtained.

The tester utilizes air from a plant or portable compressed air supply source, and is capable of handling free air up to 200 cfm at pressures to 90 psi.

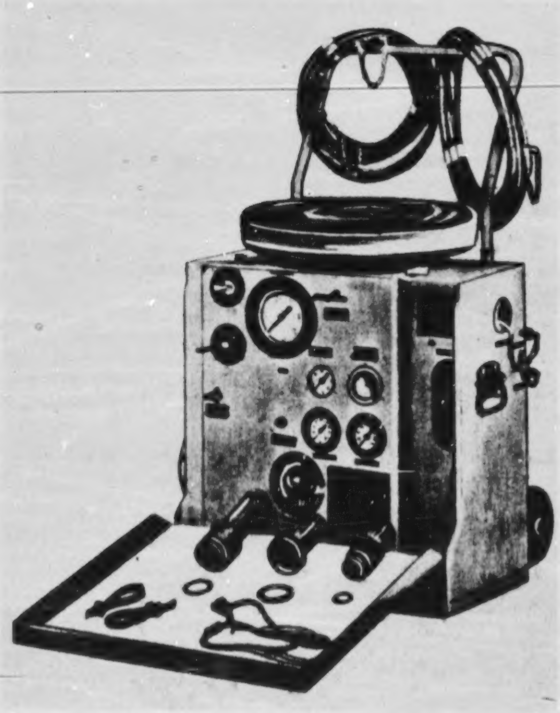

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Figure 7-12.—Portable pressurized cabin leakage tester.

DETAILED DESCRIPTION

In studying the following detailed description of the various components of the test unit, frequent reference should be made to the pneumatic schematic, figure 7-13, for this tester.

Air Inlet Filter

The air inlet filter (9) incorporates a replaceable micronic type filter element and insures filtered air supply to the test system and aircraft.

Cabin Pressure Adjustment

The cabin pressure adjustment (16), located on the instrument panel, is a pilot valve assembly that controls the pressure at which the main relief valve (18) will dump input air. It controls the pressure applied against a diaphragm in the main relief valve. A spring-loaded restrictor in the pilot valve accomplishes the pressure regulation. The spring-load is controlled by varying the position of the knurled adjusting knob.

A dial with one psi increment markings rotates with the adjusting knob to give an indication of the pressure setting at which the main relief valve will dump. A safety relief valve (17), set at 13 psi, is connected into the control pressure line between the pressure adjustment (16) and the main relief valve (18) to limit control pressure applied to the main relief valve to a 13 psi maximum.

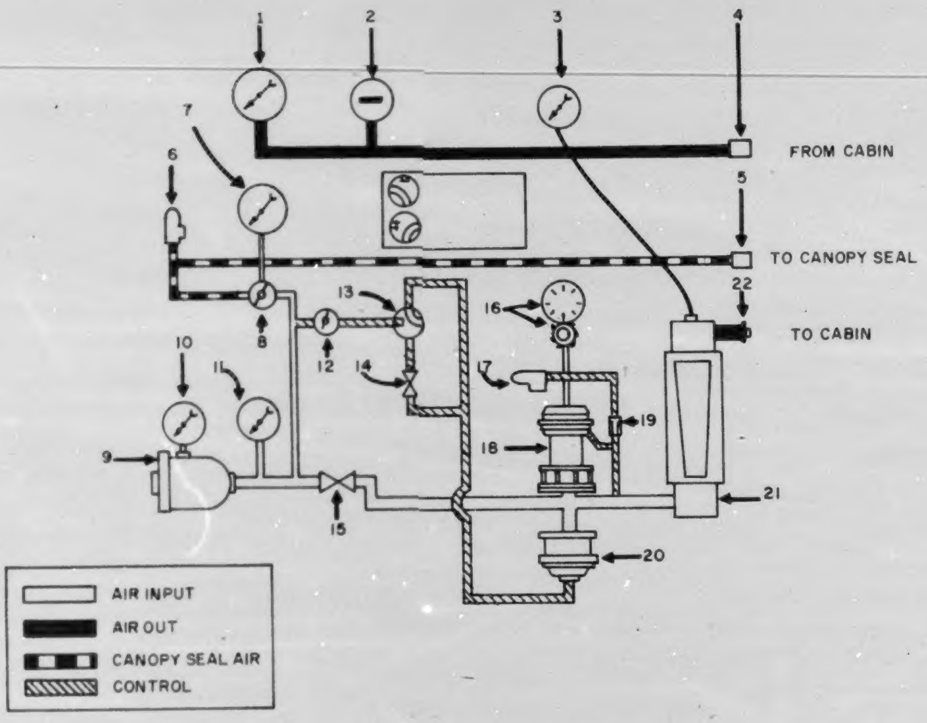
Relief Valve Assembly

The main relief valve (18) consists of two air chambers separated by a diaphragm. The center of the diaphragm is reinforced with metal plates. A long rod, attached to the metal plates and diaphragm, extends into a third chamber containing a spring-loaded plunger and neoprene seat. The neoprene seat acts as the base of the relief valve assembly.

Pressurized air is retained in the system by the seal established by the neoprene seat contacting the lip of the metallic seat. Balanced air pressure in the two air chambers, as opposed to the spring-loaded plunger and seat and inlet air pressure, determines the pressure at which the valve will relieve. The top air chamber is connected to the lower air chamber and the cabin pressure adjustment on the instrument panel. The lower air chamber is also connected into the main air stream downstream of the relief valve. If the setting of the cabin pressure adjustment is below the input air pressure, air escapes from the upper air chamber through the cabin pressure regulator faster than it enters the chamber. This causes an imbalance which actuates the diaphragm in the main relief valve, allowing input air pressure to unseat the relief valve, relieving input air pressure to atmosphere.

Rate Valve

The rate valve (20) automatically limits the rate of cabin pressure increase or decrease to a pre-set value selected by the operator. This valve operates in conjunction with the rate control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AIR INPUT
AIR OUT
CANOPY SEAL AIR
CONTROL
AM.627

1. Rate of cabin pressure change indicator.
2. Cabin pressure gage.
3. Air temperature gage.
4. and 5. Bulkhead union.
6. Relief valve.
7. Canopy seal pressure gage.
8. Canopy seal pressure regulator.
9. Filter assembly.
10. Filter inlet pressure gage.
11. Filter outlet pressure gage.
12. Air pressure regulator.
13. Rate selector valve.
14. Rate control valve.
15. Flow control valve.
16. Pressure adjustment.
17. Relief valve.
18. Main relief valve.
19. Restrictor.
20. Rate valve.
21. Flowmeter.
22. Air outlet.

Figure 7-13.–Pneumatic schematic.

valve (14), rate selector valve (13), and air pressure regulator (12).

The rate control valve meters air into and out of the upper chamber of the rate valve, and thus controls the actual rate of pressure increase or decrease in the aircraft cabin. The rate selector valve controls the operation of the rate valve, through the tester start, increase, and decrease operations. The control pressure regulator is factory set to maintain the control air pressure supplied to the rate valve at a constant 12 psi during increase operations.

Flowmeter

The flowmeter (21) indicates the rate of cabin air leakage. It consists of a tapered Pyrex glass tube which contains a steel float. The float is free to rise and fall between upper and lower stops incorporated in the flowmeter. Air flowing through the flowmeter assembly raises the float off the lower stop. The height to which the float ascends is directly proportional to the flow rate.

The tube is etched with a special scale to facilitate reading pressure-corrected flow at any pressure from 0 to 12.4 psi. An instruction plate of flowmeter reading instructions is attached to the instrument panel. Input air pressure is represented by vertical lines which are numbered at the bottom of the scale from 0 to 12.5 psi.

Airflow in cubic feet per minute of standard air (14.7 psi at 70°F) is represented by diagonal or curved lines. Capacity of the flowmeter is 0 to 200 cubic feet per minute at 2 to 12.5 psi. The flowmeter is calibrated for an air temperature of 70°F. For other temperatures, corrections must be made to obtain the correct flow. A temperature correction curve is provided on the instrument panel.

Flow Control Valve

The flow control valve (15) is a manually operated globe valve that admits the air supply to the tester system.

General operating precautions

Prior to the actual operation of the tester the operator must be familiar with safety precautions connected with this equipment.

1. If mechanics are to be inside the aircraft during the pressure test, it is advisable that some form of communication with the tester operator and the personnel inside the aircraft be provided.

2. When reducing pressure of the cabin with personnel present inside the aircraft, reduction of pressure must be slow and gradual.

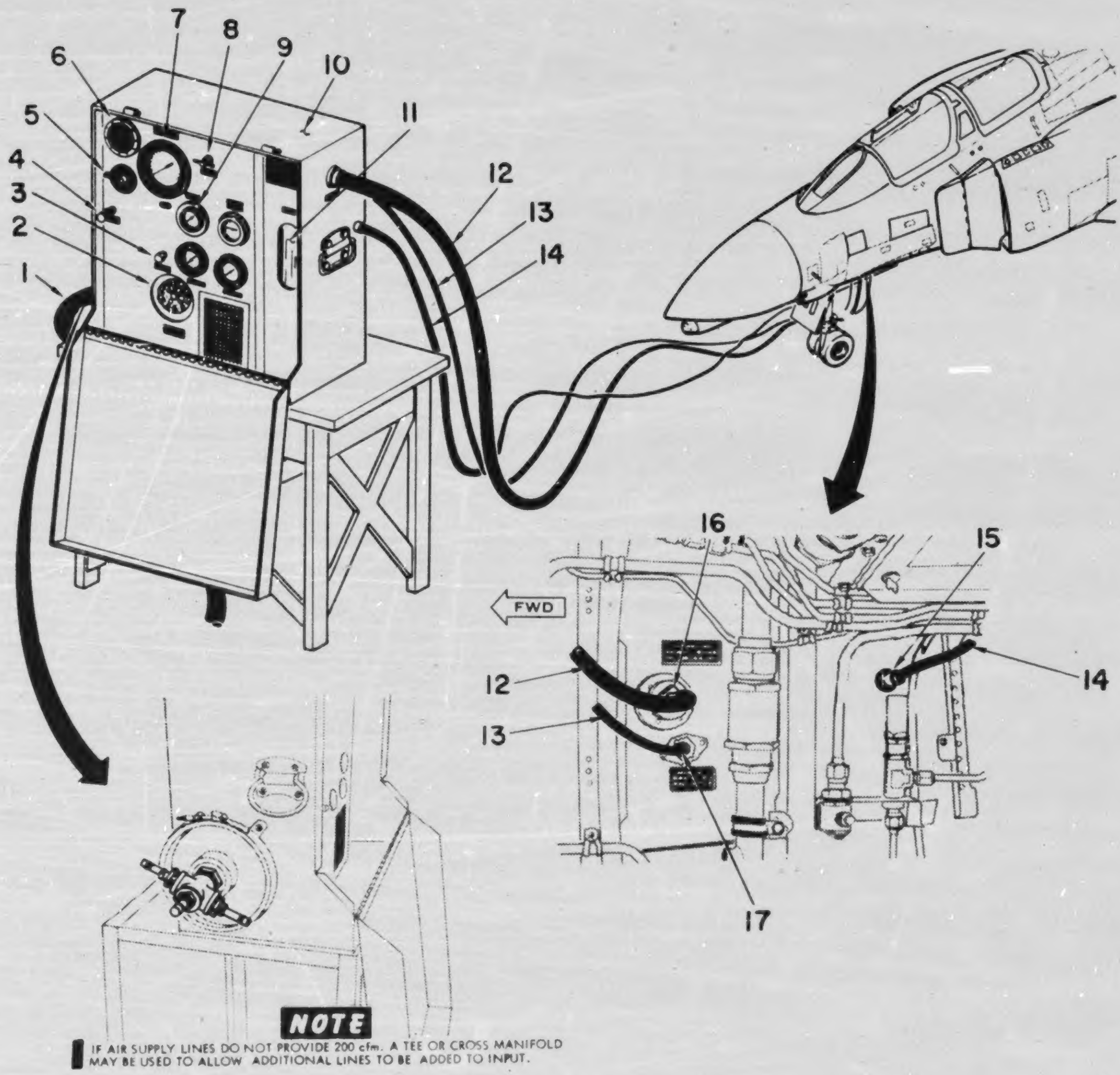
3. The relief valve provided in the tester operates over a wide range as determined by setting of the pressure adjustment on the instrument panel. This should not be relied on implicitly by the operator. Assuming the relief valve is malfunctioning, or the pressure adjustment is not set at the correct pressure, it is possible to blow out the windows or to rupture the structure of the aircraft being tested.

4. Air to the cabin should not exceed 120°F and cabin pressure should not be increased or decreased at rates above 250 ft per minute at flows from 50 to 250 cfm, or at 500 ft per minute at flows from 10 to 50 cfm.

5. When resetting tester for a lower test pressure, always decrease the cabin pressure to a point below the desired new test pressure,

NOMENCLATURE FOR FIGURE 7-14.

1. Air source.
2. Flow control valve.
3. Pressure adjustment.
4. Rate control valve.
5. Rate selector valve.
6. Rate of pressure change indicator.
7. Cabin pressure indicator.
8. Canopy seal regulator.
9. Canopy seal pressure indicator.
10. Pressurized cabin leakage tester.
11. Flowmeter.
12. Outlet pressure hose.
13. Static hose.
14. Canopy seal pressure hose.
15. Canopy seal test fitting.
16. Cabin pressure test inlet fitting.
17. Cabin static air pressure test fitting.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NOTE

IF AIR SUPPLY LINES DO NOT PROVIDE 200 cfm. A TEE OR CROSS MANIFOLD MAY BE USED TO ALLOW ADDITIONAL LINES TO BE ADDED TO INPUT.

AM.624

Figure 7-14.–Cabin pressure tester hookup (F-4).

before resetting the cabin "PRESSURE ADJUSTMENT". Use the same procedure when resetting for a higher test pressure.

OPERATION

Prior to starting the tester, accomplish the required daily inspection, maintenance procedures, and prestart instructions.

To operate the portable cabin pressure leakage tester, position the test unit as near as possible to the external aircraft test fitting connections. Connect the three 25-foot tester hoses to these fittings as directed by the applicable Maintenance Instructions Manual. See figure 7-14 for an illustration of a cabin pressure tester hookup.

Refer to figure 7-13 to aid in following the operation of the tester.

At this time, connect an external air source to the portable leakage tester, insuring it is receiving at least 200 cfm. The tester is then ready to be operated and should be done in accordance with the instructions found in the Operation and Servicing Manual for this unit.

The leakage tester is started with the rate control valve (14) closed and the rate selector valve (13) in the start position. This vents the pressurized control chamber of the rate valve to atmosphere and the valve moves to the full open position, bypassing the input air to atmosphere.

The rate control valve (14) is opened slowly, in increments of one-sixteenth of a turn, allowing the system time to stabilize between adjustments, until desired rate of increase (as indicated on the rate of cabin pressure change gage (1)) is obtained. As the rate control valve (14) is adjusted, the rate valve (20) closes slowly until the pressure setting of the main relief valve (18) is reached, at which time the relief valve operates to hold the pressure at a preset value. Proceed with the cabin leakage test according to the instructions found in the applicable Maintenance Instructions Manual.

Upon completion of test, the rate selector valve (13) is operated to decrease, bleeding the control air pressure from the control chamber of the rate valve, thus, allowing the valve to open slowly and dump the cabin air pressure. The source of air is then shut off and all hoses between the test unit and aircraft are disconnected.

MAINTENANCE DOCUMENTATION BY AN ASSISTING WORK CENTER

Malfunctions of the air-conditioning system could be an electrical or mechanical nature or, in the case of the vapor cycle system, it could be electrical, mechanical, or hydraulic. When isolation and correction of a malfunction requires the services of more than one rating and/or work center, the work center that the discrepancy is most likely to concern is designated the primary work center. Any other work centers which are involved in either the isolation or correction (or both) of the discrepancy is designated as the assisting work center.

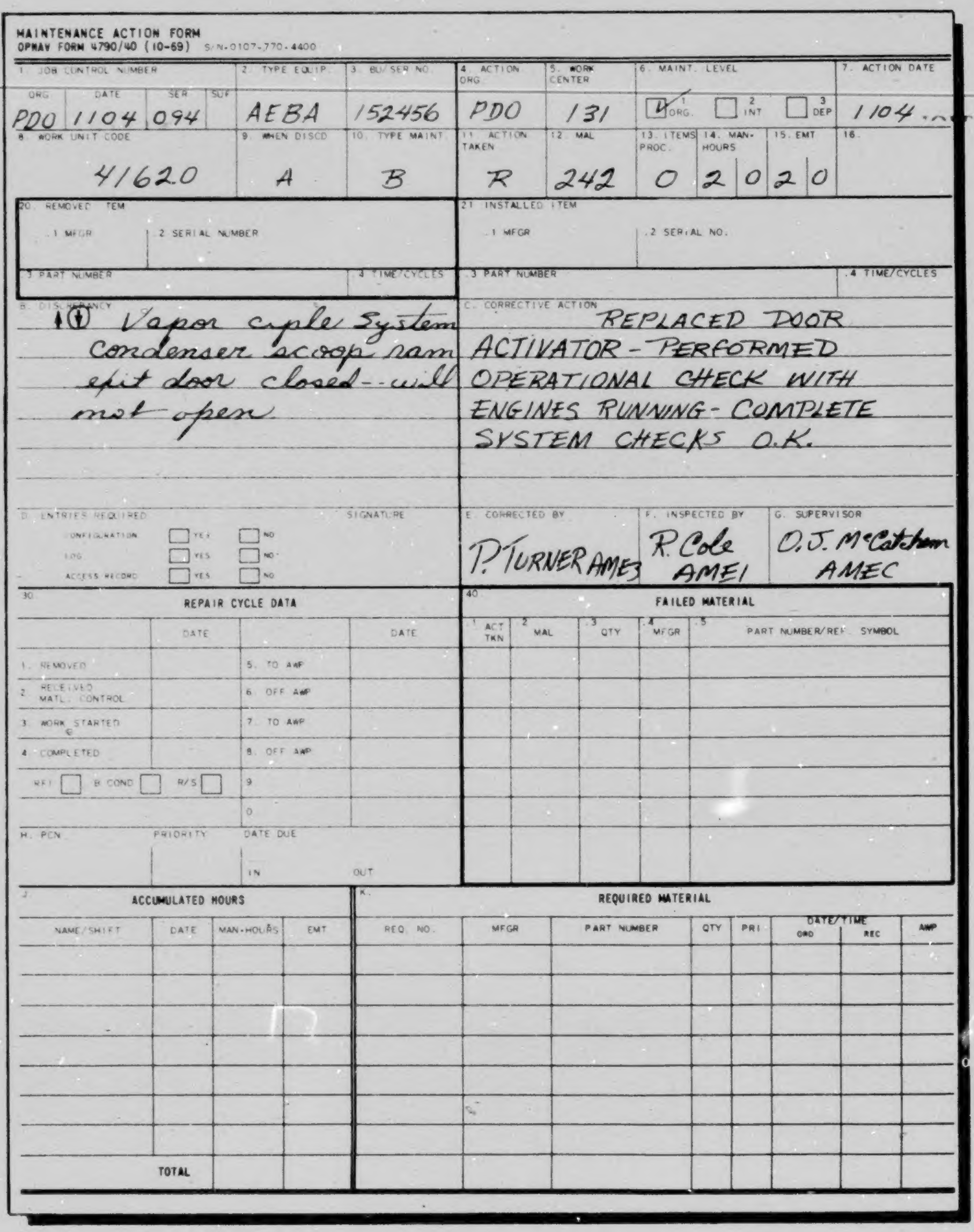
The assisting work center will account for its manhours utilizing a single copy Maintenance Action Form (MAF). Figure 7-15 provides an example of a single copy MAF originated by an AME assigned to work center 131 who provided assistance to the activity's electric shop in performing an operational check of the vapor cycle system and correcting a discrepancy.

The data elements on the MAF turned in by the assisting work center will match those on the MAF turned in by the primary work center except as follows: Block 5 will reflect the assisting work center's code, block 13 will show 0 items processed, and blocks 14 and 15 will reflect the manhours and elapsed maintenance time actually used in assisting the primary work center.

Block 7, the action date, may or may not differ since it reflects the date of completion of the assistance and not the correction of the primary discrepancy.

No entries will appear in blocks 20, 21, or 40. The narrative description and corrective action may or may not be the same as that of the primary work center.

Complete information for documenting maintenance actions is provided in Military Requirements for Petty Officer 3 & 2, NavPers 10056-C, and OpNav Instruction 4790.2 (Series).



MAINTENANCE ACTION FORM
OPNAV FORM 4790/40 (10-69) S/N-0107-770-4400

1. JOB CONTROL NUMBER ORG PDO	DATE 1104	SER 094	SUF	2. TYPE EQUIP. AEBA	3. BU/SER NO. 152456	4. ACTION ORG PDO	5. WORK CENTER 131	6. MAINT. LEVEL ☑ 1 ORG. ☐ 2 INT ☐ 3 DEP		7. ACTION DATE 1104
8. WORK UNIT CODE 41620				9. WHEN DISCD A	10. TYPE MAINT. B	11. ACTION TAKEN R	12. MAL 242	13. ITEMS PROC. 0	14. MAN-HOURS 2 0	15. EMT 2 0
16.										

20. REMOVED ITEM .1 MFGR	.2 SERIAL NUMBER	21. INSTALLED ITEM .1 MFGR	.2 SERIAL NO.
.3 PART NUMBER	.4 TIME/CYCLES	.3 PART NUMBER	.4 TIME/CYCLES

B. DISCREPANCY ↑① Vapor cycle System condenser scoop ram exit door closed--will not open	C. CORRECTIVE ACTION REPLACED DOOR ACTIVATOR - PERFORMED OPERATIONAL CHECK WITH ENGINES RUNNING - COMPLETE SYSTEM CHECKS O.K.

D. ENTRIES REQUIRED			SIGNATURE		
CONFIGURATION ☐ YES ☐ NO				E. CORRECTED BY P. TURNER AME3	F. INSPECTED BY R. Cole AME1
LOG ☐ YES ☐ NO					G. SUPERVISOR O.J. McCatchem AMEC
ACCESS RECORD ☐ YES ☐ NO					

30. REPAIR CYCLE DATA

	DATE		DATE
1. REMOVED		5. TO AWP	
2. RECEIVED MATL. CONTROL		6. OFF AWP	
3. WORK STARTED		7. TO AWP	
4. COMPLETED		8. OFF AWP	
RFI ☐ B COND ☐ R/S ☐		9	
		0	
H. PCN	PRIORITY	DATE DUE IN	OUT

40. FAILED MATERIAL

.1 ACT TKN	.2 MAL	.3 QTY	.4 MFGR	.5 PART NUMBER/REF. SYMBOL

J. ACCUMULATED HOURS

NAME/SHIFT	DATE	MAN-HOURS	EMT
TOTAL			

K. REQUIRED MATERIAL

REQ. NO.	MFGR	PART NUMBER	QTY	PRI	DATE/TIME ORD	DATE/TIME REC	AWP

AM.1142

Figure 7-15.—Documenting an assist maintenance action.

CHAPTER 8

EMERGENCY EGRESS SYSTEMS

Emergency egress systems are designed to provide every possible means for pilots (and crewmen) to evacuate aircraft in the event of an emergency while airborne, crash landing, or ditching. Egress systems include canopies that can be jettisoned or manually removed and seat ejection systems that assure the sequenced escape of pilot and crewmen. Current seat ejection systems are designed to be used at ground level, at zero airspeed in some aircraft, and throughout the maximum altitude and airspeed capabilities of high-performance aircraft.

In this chapter some of the various types of canopy systems and ejection seats that are in use today in naval aircraft will be discussed.

Canopies and ejection seats are two of the most dangerous and hazardous systems of today's aircraft, and for this reason, safety should be stressed to its fullest measure. All personnel involved in working on or with aircraft equipped with ejection seats and jettison type canopies should be thoroughly indoctrinated as to the hazards and dangers of these systems and what safety precautions are to be observed at all times.

The training program of every activity should be set up so as to include canopy and ejection seat checkout for all personnel in the maintenance department or flight personnel as a part of the check-in procedure.

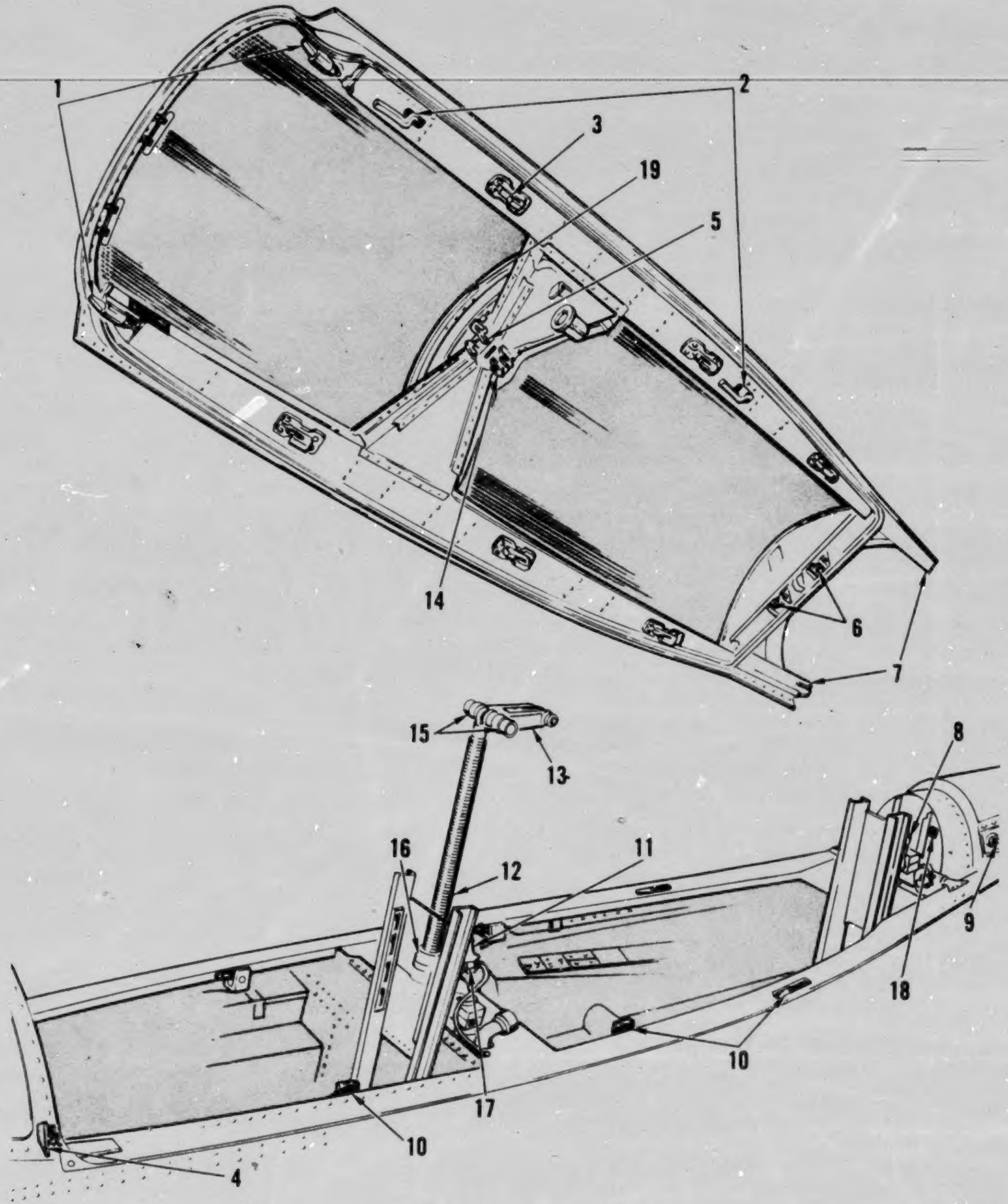
Accidents are generally caused by human error, and only through constant supervision and training of personnel can we hope to avoid them. Therefore, as a senior AME, it is your responsibility to insure that all safety precautions pertaining to ejection seats and canopies are known and carried out in detail.

ELECTRICALLY OPERATED CANOPY SYSTEM

A typical example of an electrically operated canopy system is the T-2B clam shell installation. There are three methods provided for operation to permit cockpit entrance or exit under all predictable conditions. Normal opening and closing of the canopy is accomplished electrically. Emergency entrance or exit is accomplished by jettisoning the canopy. The canopy can also be manually opened (and pushed from the aircraft as an alternate emergency entrance or exit). All three methods of opening the canopy can be accomplished from either cockpit or from outside the cockpit. (Figure 8-1 illustrates the canopy system hardware.)

NOMENCLATURE FOR FIGURE 8-1.

1. Canopy wedge fittings.
2. Canopy manual release handle.
3. Canopy side hooks (typical 6 places).
4. Canopy wedge lock rollers.
5. Canopy uplock hooks.
6. Aft track guide rollers.
7. Canopy pivot forks.
8. Canopy aft tracks.
9. Canopy pivot point (typical 2 places).
10. Canopy side hook lock rollers (typical 6 places).
11. Canopy forward tracks.
12. Canopy actuator jackscrew.
13. Jackscrew end fittings.
14. Canopy beam aft hooks.
15. Forward track guide rollers.
16. Gimbal support.
17. Canopy closed and latched limit switch.
18. Canopy open limit switch.
19. Splice bow.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AM.637

Figure 8-1.–Canopy system hardware.

NORMAL SYSTEM OPERATION

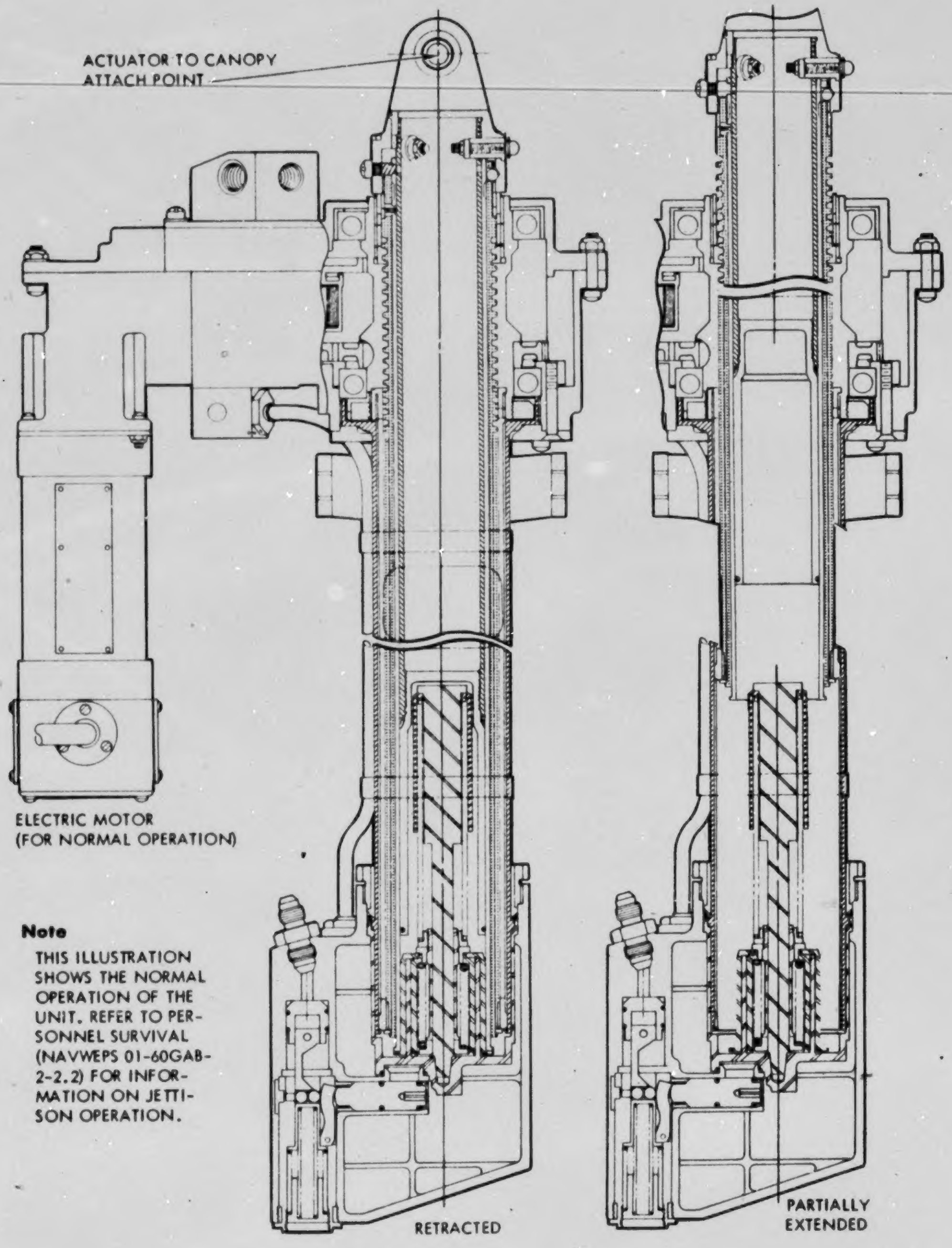
The normal canopy operating system is electrically operated and controlled. A canopy actuator/remover, figure 8-2, consisting mainly of a electric motor driving a jackscrew through a reduction gearbox, is secured to the canopy structure with the arm on the end of the jackscrew engaged in one of the two sets of hooks on the canopy beam, depending on the canopy being opened or closed.

A 3000 psi air charge is contained within the reservoir located on the bottom of the actuator assembly. Four electrical switches are provided for control of the canopy. The two internal switches are toggle-type and are spring-loaded to the center position. They are located in each cockpit above the left-hand console. To close the canopy, push the toggle switch to the "CLOSE" position and hold. To open the canopy, pull out on the toggle switch and push to the "OPEN" position and hold. On the T-2C BUNO 157046 and subsequent and T-2B/T-2C aircraft having AFC No. 150 incorporated, the canopy toggle switches must be pulled to open or close the canopy. This prevents accidental movement of the switch when entering or leaving the cockpit. (This type toggle switch is locked in the center position by a spring that must be compressed by pulling to move the switch from the center position.) Two momentary external control switches are located on the left-hand side of the fuselage, one for opening and one for closing the canopy. The normal canopy operating system is wired directly to the battery and canopy bus; therefore, the canopy may be opened or closed regardless of the position of the BATTERY switch when the weight of the aircraft is on the landing gear. If the weight of the aircraft is not on the landing gear, the BATTERY switch must be positioned to "OFF." Power to the canopy open relay is controlled through the canopy open limit switch and contacts on the ground safety relay No. 2, which permits the canopy to be opened only when the aircraft is on the ground. When the aircraft is on the ground, the ground safety relay No. 2 is deenergized by the actuation of the ground safety switch, located on the left-hand main landing gear. When the aircraft is airborne, the ground safety switch energizes the ground safety relay No. 2, thereby removing power from the open circuit of the canopy actuating system. The power to the close circuit of the canopy actuating system is controlled by the canopy locked sensing switch, which energizes the canopy close relay until the canopy is locked, at which time the locked sensing switch is opened. When any one of the CANOPY control switches is held in the "OPEN" position, power from the battery and canopy bus is directed through the CANOPY OPEN LIMIT switch and contacts on the ground safety relay No. 2 to energize the canopy open relay and actuate the canopy actuator motor.

When any one of the three canopy control switches is held to the OPEN position, the open winding in the canopy actuator is energized. The canopy actuator then extends the jackscrew, which (through cam action) moves the canopy aft approximately 1 inch to disengage the six sidehooks (fig. 8-3(A).)

As the screw jack moves up, the downlock roller engages the uplock hook, which is utilized to prevent the canopy from accidentally disengaging the downlock hook. When the canopy opens to the full-up position (approximately 25 degrees or 51 inches (+½) from the top of the windshield bow to the top of the canopy bow), the canopy open limit switch, which is externally mounted on the bulkhead behind the aft canopy frame, is contacted (deactuated) by a roller located on the aft portion of the canopy frame. This deenergizes the canopy actuator.

When any one of the three canopy control switches is held to the CLOSED position, power from the canopy and battery bus is directed through the canopy locked limit switch to energize the canopy close relay, which in turn energizes the winding of the canopy actuator. The actuator then retracts the jackscrew to close the canopy. When the uplock hook rollers engage the canopy forward tracks, the uplock hooks are caused to disengage from the downlock rollers. At this point, the downlock rollers contact and follow the cam track of the canopy

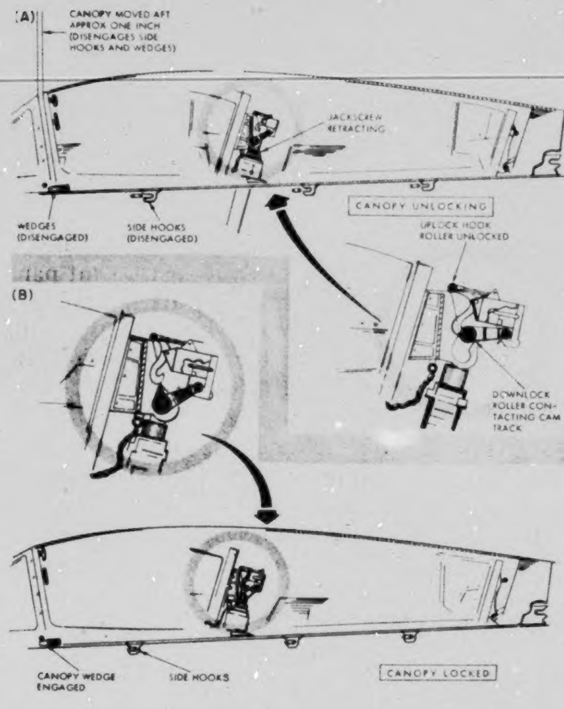

ACTUATOR TO CANOPY ATTACH POINT
ELECTRIC MOTOR (FOR NORMAL OPERATION)
RETRACTED
PARTIALLY EXTENDED

Note

THIS ILLUSTRATION SHOWS THE NORMAL OPERATION OF THE UNIT. REFER TO PERSONNEL SURVIVAL (NAVWEPS 01-60GAB-2-2.2) FOR INFORMATION ON JETTISON OPERATION.

AM.638

Figure 8-2.–Canopy actuator/remover.


(A)
CANOPY MOVED AFT APPROX ONE INCH (DISENGAGES SIDE HOOKS AND WEDGES)
JACKSCREW RETRACTING
WEDGES (DISENGAGED)
SIDE HOOKS (DISENGAGED)
CANOPY UNLOCKING
UPLOCK HOOK ROLLER UNLOCKED
(B)
DOWNLOCK ROLLER CONTACTING CAM TRACK
CANOPY WEDGE ENGAGED
SIDE HOOKS
CANOPY LOCKED

AM.635

Figure 8-3.—Canopy unlocking and locking sequence.

forward tracks, causing the canopy to move forward approximately 1 inch to engage the canopy latches. (Refer to figure 8-3 (B).) Upon reaching the full forward position, an arm of the canopy locked sensing switch is contacted by a downlock roller deactuating the canopy locked sensing switch. This switch is externally mounted on the aft side of the forward seat bulkhead and the canopy forward tracks. Deactuating this switch deenergizes the canopy actuator, extinguishes the CANOPY UNLOCKED light, and actuates the canopy seal system.

Operation of Canopy Actuator/Removal

The canopy actuator assembly is the electromechanical type. (See fig. 8-2.) During normal operation, a reversible electric motor extends or retracts a jackscrew by means of a reduction gearbox. For normal operation the actuator jackscrew should operate through its normal stroke in 1 to 12 seconds with 26-volt d-c power applied. The electric motor has a duty cycle of 3 minutes on and 17 minutes off. Canopy motion in the closed direction is controlled by an externally mounted closed limit switch. When the canopy is closed and locked, the limit switch deenergizes the actuator. Canopy motion in the open direction is controlled by an externally mounted open limit switch. The actuator motor is deenergized by the open limit switch when the canopy is open approximately 25 degrees or 51(+½) inches from the top of the windshield bow to the top of the canopy bow. Nonjamming stops are incorporated into the actuator to restrict jackscrew travel if the open limit switch fails. A magnetic clutch prevents excessive coasting of the unit when the motor is deenergized. Clean, dry air or nitrogen is stored at 3000 psi within the actuator for jettisoning operations. The air reservoir is serviced through the filler valve near the top of the actuator. An air gage, a high-pressure air filler valve, and a relief valve are an integral part of the actuator assembly. When one of the canopy jettison initiators is actuated, the expanding gases operate a plunger in the base of the actuator. The spring-loaded plunger moves down, permitting a ball retained latch to rotate down. Compressed air in the reservoir then forces the valve piston to move over with the latch, thus permitting air pressure to enter the remover tube chamber. As pressure builds up in the chamber, the locking balls drop free of jackscrew. The compressed air then extends the remover tube and jettisons the canopy.

CAUTION: The canopy actuator remover is a permanently assembled unit. The only maintenance authorized on the unit is removal, installation, and servicing with air. The unit should never contain an air charge unless installed in the aircraft. The air charge must be released before removal of the canopy or the actuator/remover. If the unit indicates an unlocked condition as explained in the following, the unit must be replaced. A ground safety pin device is provided for the canopy actuator/remover. The device functions to form a positive lock between the jackscrew and the remover tube. In the event that the remover tube-locking mechanism becomes unlocked because of a faulty unit or as a result of inadvertent actuation of a canopy jettison system initiator, the safety pin device would serve to prevent the remover tube from jettisoning the canopy. If at any time, especially after servicing the actuator/remover with air, the safety pin device cannot be removed due to (binding), immediately release the air charge from the unit. Binding of the safety pin device indicates that the remover tube is unlocked and that the safety pin device alone is the only thing preventing the remover tube from jettisoning the canopy. Do not try to force or pry a binding safety pin device from the actuator/remover. Instead, release internal actuator air pressure by slowly opening actuator filler valve, and replace actuator. A decal plate, containing information relative to the contents of this warning, is located on the shroud of the aft cockpit instrument panel.

EMERGENCY SYSTEM OPERATION

Provisions have been incorporated to jettison the canopy if it becomes necessary to abandon the aircraft in flight. This is accomplished automatically whenever the ejection system is initiated by either the forward or aft ejection seat. Refer to figure 8-4. The canopy can also be jettisoned when it is not desired to eject the seat. This is accomplished by pulling the canopy jettison "T" handle located on the left-hand side of the instrument panel above the left-hand console in each cockpit. The canopy can also be jettisoned on the ground from outside by pulling on a handle attached to a 6-foot lanyard. The lanyard handle is located behind an access door on the left-hand side of the fuselage, and pointed out by a RESCUE ARROW. (Fig. 8-5, detail C.) Pulling either the canopy jettison handle or the external lanyard fires a mechanically-actuated gas initiator. The gas pressure thus created is routed through flexible stainless steel lines to the bottom of the canopy actuator/remover. Gases from the fired initiator release a high-pressure air source contained in the canopy actuator/remover tube. Acting against the actuator tube, the compressed air moves the canopy through normal course and free of the aircraft.

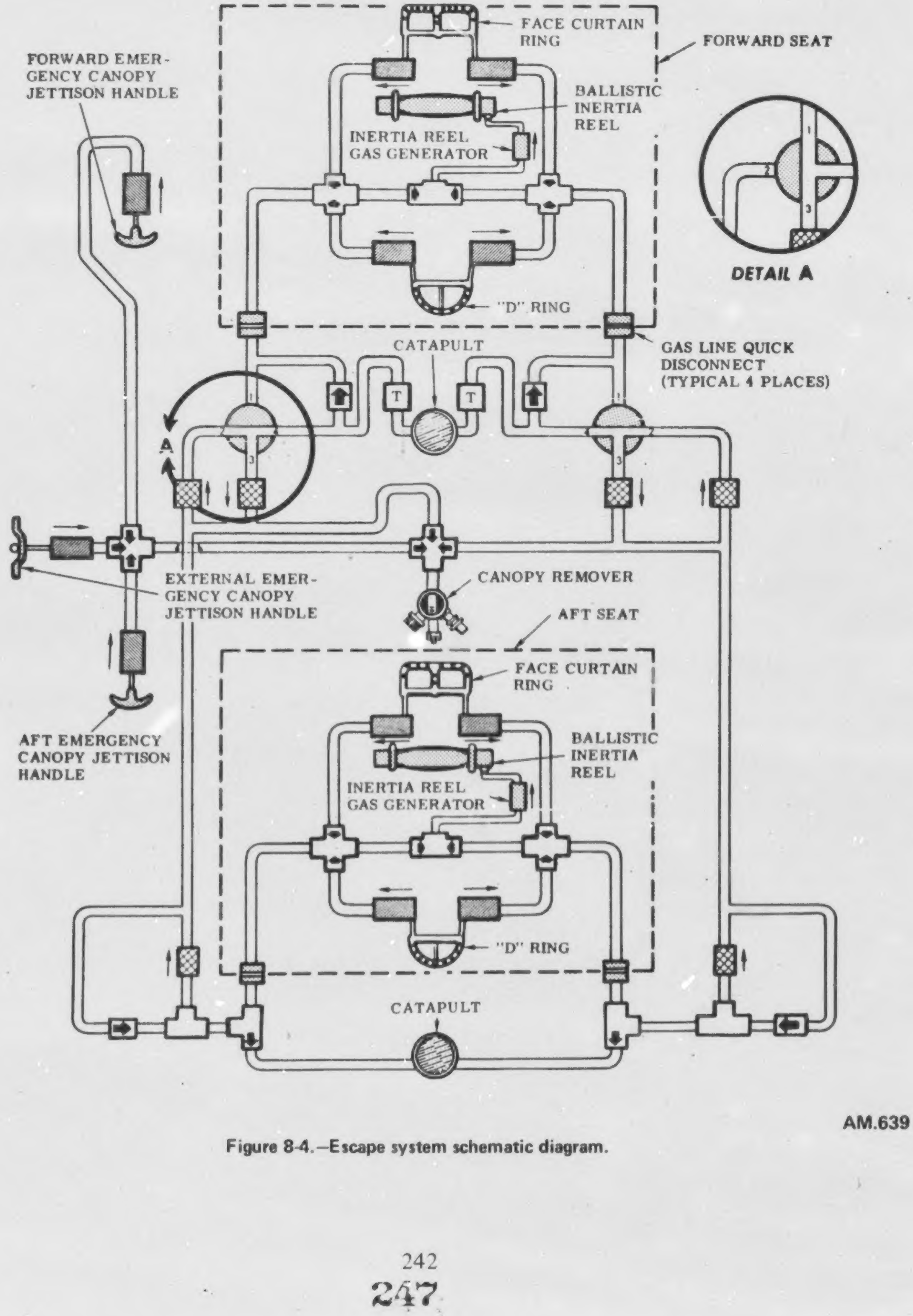
NOTE: Actuation of the canopy jettison handles will jettison the canopy only when the canopy actuator jackscrew is in the retracted position (canopy closed) within 0 (+0.75/-0.25) inch of the normal retracted position.

A CANOPY EMERG REL handle is located in each cockpit, adjacent to the instrument panel above the left-hand console. Each handle is connected to a mechanically-actuated initiator, located forward and below the vicinity of the handle (figure 8-5, detail A,B.) Pulling either handle fires the respective initiator, the gas pressure of which actuates the canopy actuator/remover to jettison the canopy. Both handles require a flagged ground safety pin whenever the aircraft is on the ground. During installation or removal of the handles or the initiators, a shipping safety pin must be installed in the initiator.

A CANOPY EMERGENCY JETTISON handle is located behind a quick-opening access door on the starboard side of the fuselage and pointed to by a RESCUE ARROW (figure 8-5, detail C). The handle is mounted in a spring clip and attached to a 6-foot cable which is wound into the cavity. The other end of the cable is attached to the sear pin of a mechanically-actuated initiator. When the handle is pulled, the cable unwinds. When the slack in the cable is taken up, the sear pin is pulled and the initiator fires. The gas pressure actuates the canopy actuator remover and the canopy is jettisoned.

MANUAL OPERATION

Operation of the canopy manual release system is performed by manually actuating any one of three handles on the canopy (See Fig. 8-7). The locations of these handles are on the left-hand side of the canopy and are situated in a manner that makes one of these accessible from each of the following locations: (1) forward cockpit, (2) aft cockpit, and (3) outside the cockpit on the port side. These handles are interconnected to the canopy actuator hooks by mechanical linkage. Actuation of the linkage by pulling any one of the handles causes the


FACE CURTAIN RING
FORWARD SEAT
FORWARD EMERGENCY CANOPY JETTISON HANDLE
BALLISTIC INERTIA REEL
INERTIA REEL GAS GENERATOR
DETAIL A
1
2
3
"D" RING
CATAPULT
GAS LINE QUICK DISCONNECT (TYPICAL 4 PLACES)
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T
A
EXTERNAL EMERGENCY CANOPY JETTISON HANDLE
CANOPY REMOVER
AFT SEAT
FACE CURTAIN RING
BALLISTIC INERTIA REEL
INERTIA REEL GAS GENERATOR
AFT EMERGENCY CANOPY JETTISON HANDLE
"D" RING
CATAPULT
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Figure 8-4.—Escape system schematic diagram.

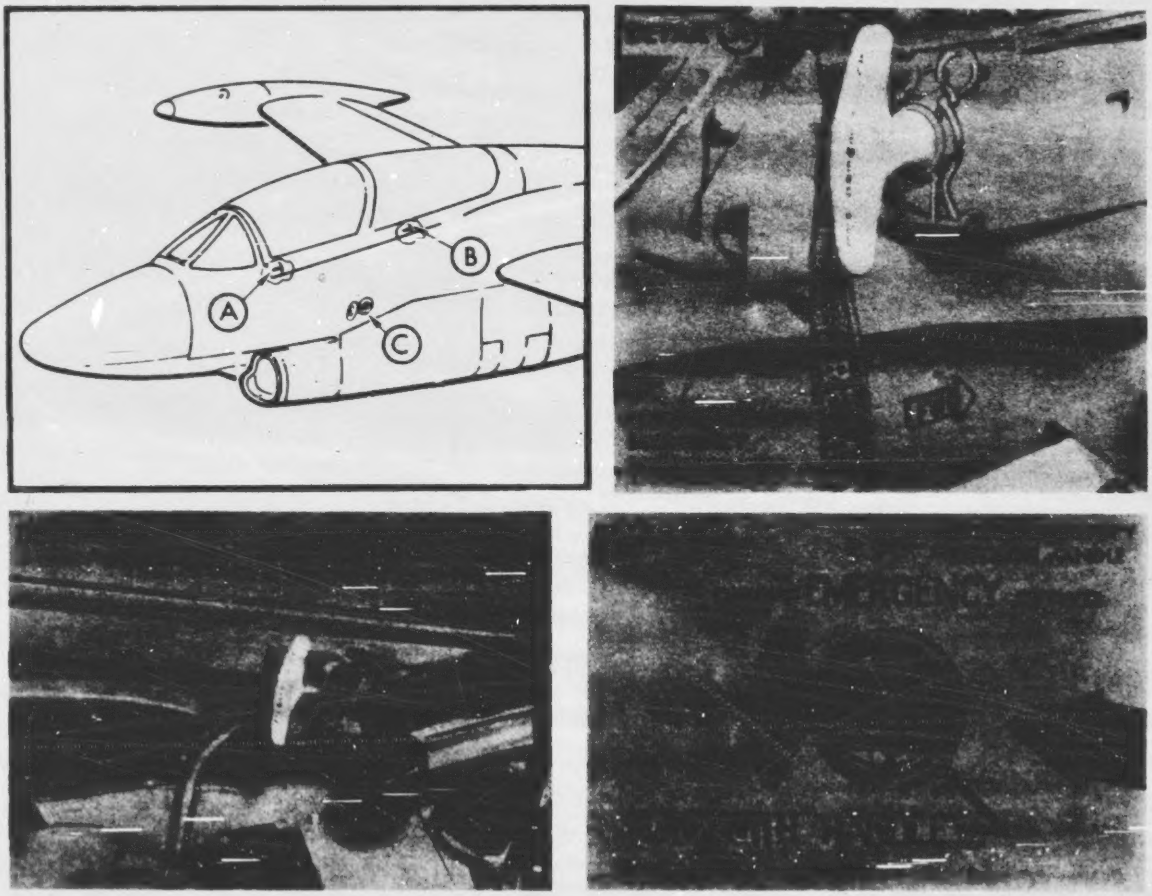

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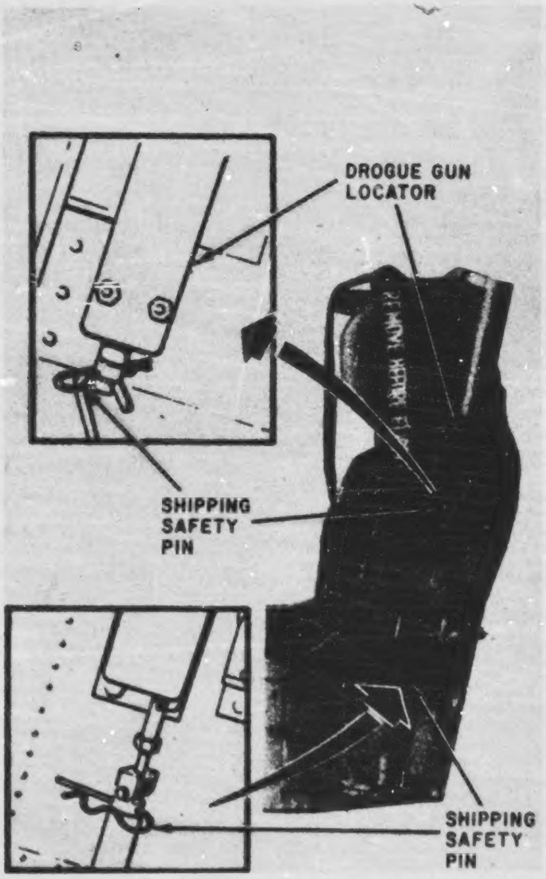
Figure 8-5.—Canopy jettison system-release handles.

actuator hooks to swing aft releasing the aft end of the actuator link from the canopy. When the canopy is closed, this will unlock the canopy from the aircraft and it can be pushed aft to disengage the side hooks and opened manually. If an emergency exists, the canopy can be removed from the aircraft in this manner by pushing it aft and up until it falls clear. When the canopy is open, an additional step is required to remove the canopy from the aircraft. The uplock hooks must be disengaged by pushing aft on the uplock hook rollers while pushing upward on the canopy.

The actuator hooks can be retained in the open position by utilizing the overcenter feature of the manual release mechanism. Normally, the manual release handles are intended for use in the event the electrical actuator becomes inoperative or under certain emergency conditions. Under these conditions, the canopy can be manually unlocked and opened far enough to allow the pilots to climb out. The manual release



AM.641

Figure 8-6.—Escape system maintenance shipping safety pins.

system is also used during normal canopy removal operations.

CANOPY SYSTEM MAINTENANCE

Maintenance of the canopy consists of troubleshooting procedures, removal and installation, and rigging of switches. Instructions and troubleshooting charts can be found in the appropriate Maintenance Instructions Manual.

Organizational maintenance of the canopy jettison system consists of removal and installation of the jettison handle initiators and canopy jettison system check valves. Detailed procedures for performing this maintenance is found in the appropriate MIM.

PNEUMATICALLY OPERATED CANOPY

An example of a pneumatically operated canopy is the EA-6B dual canopy installation. The system consists of the forward and aft canopy assemblies and various subsystems necessary for canopy operation. The subsystems include a normal canopy system to open and close the canopies, an emergency canopy jettison system to jettison the canopies, and the canopy seal system. (Canopy seal systems are covered in Chapter 9.) Normal and emergency systems are pneumatically operated from independent nitrogen bottles. Figure 8-8 is a schematic diagram of the normal system and figure 8-9 shows the emergency system. For simplicity, only the forward canopy is shown in the normal system diagram as both the canopies basically operate the same. Frequent reference should be made to these figures during study of the following operational description.

NORMAL SYSTEM OPERATION

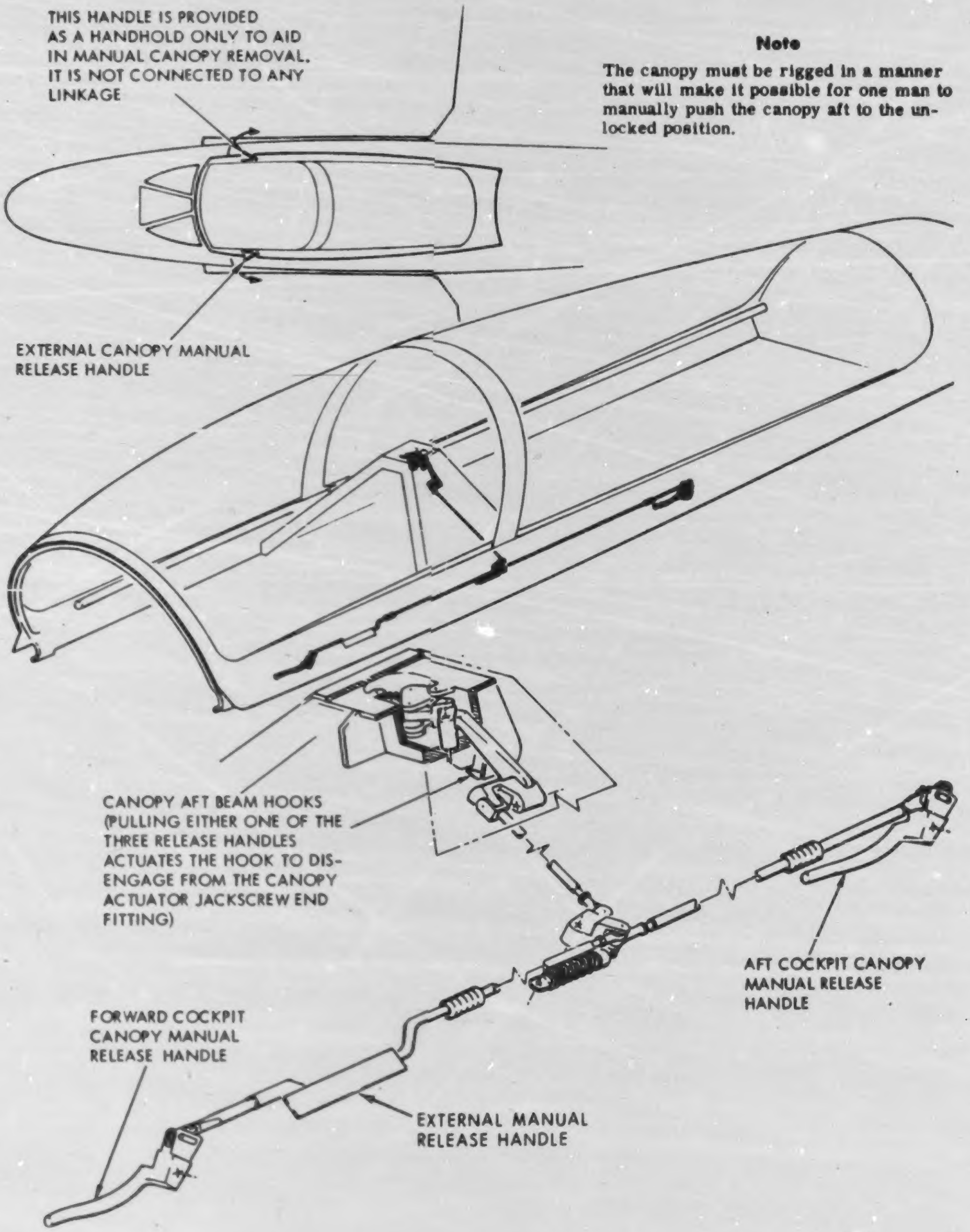
The normal canopy system functions to open and close the forward and aft canopies. There is a canopy handle in each cockpit, and an external handle on the port side of the fuselage. The forward cockpit and the nosewheel well have direct-reading pressure gages for the system. The nosewheel well gages provide exact readouts of the system pressure in psi. The pilot's gage provides only a simple readout indicating only if the normal canopy system needs to be refilled.

An auxiliary system is provided for opening the canopies if the normal system fails. Auxiliary canopy release controls are located in the forward cockpit and the nosewheel well. Actuation by either control opens both canopies.

The normal canopy system (fig. 8-10) consists of a 1,300 cubic-inch capacity nitrogen reservoir (air bottle), a 50 cubic-inch capacity auxiliary reservoir, restrictors, 325- and 610-psi pressure reducers, pressure relief valves, canopy actuating cylinders and dampers, and selector valves. Operation of the canopies is by the selector valves, actuated by the canopy handle in each

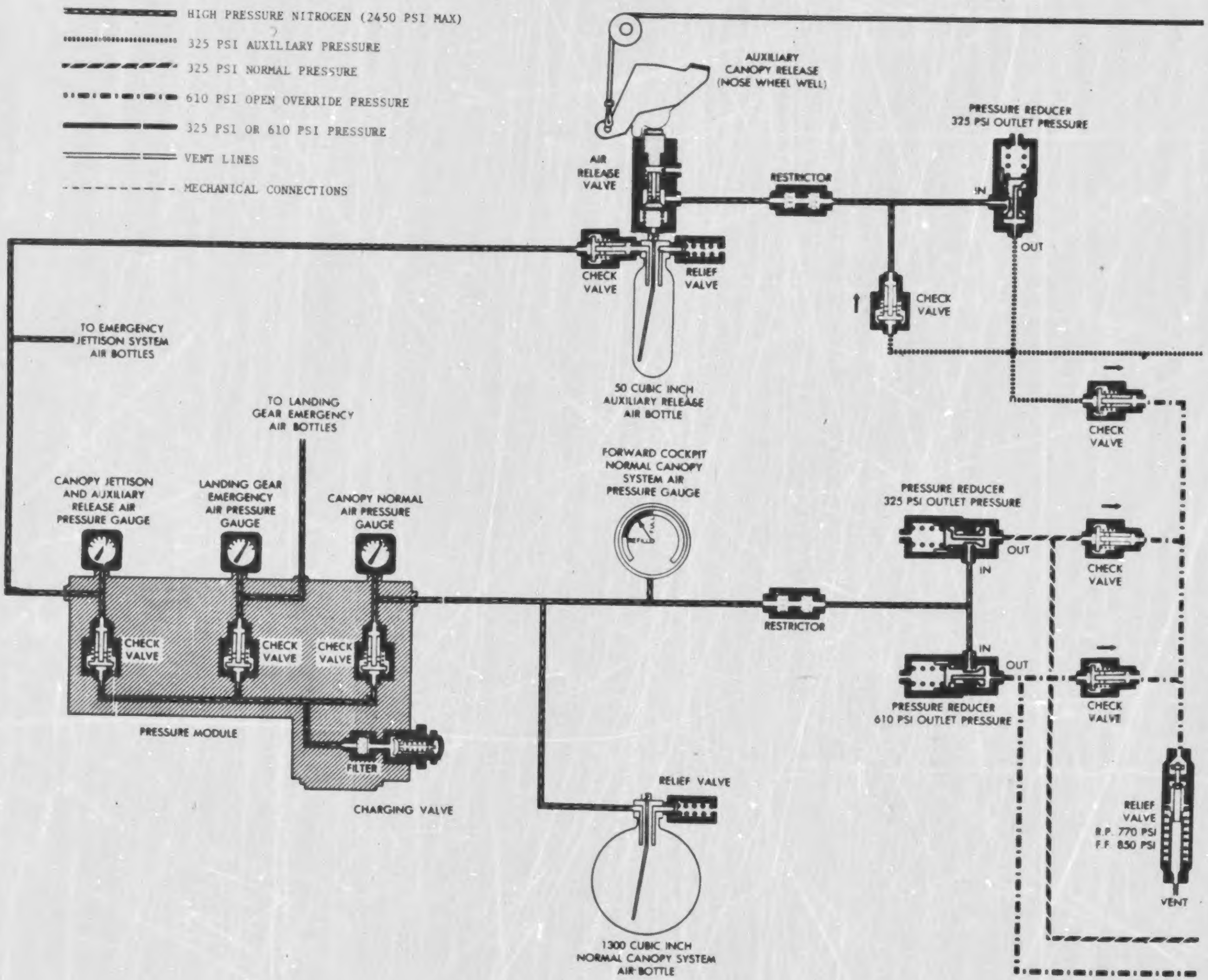
Note

The canopy must be rigged in a manner that will make it possible for one man to manually push the canopy aft to the unlocked position.


THIS HANDLE IS PROVIDED AS A HANDHOLD ONLY TO AID IN MANUAL CANOPY REMOVAL. IT IS NOT CONNECTED TO ANY LINKAGE
EXTERNAL CANOPY MANUAL RELEASE HANDLE
CANOPY AFT BEAM HOOKS (PULLING EITHER ONE OF THE THREE RELEASE HANDLES ACTUATES THE HOOK TO DISENGAGE FROM THE CANOPY ACTUATOR JACKSCREW END FITTING)
AFT COCKPIT CANOPY MANUAL RELEASE HANDLE
FORWARD COCKPIT CANOPY MANUAL RELEASE HANDLE
EXTERNAL MANUAL RELEASE HANDLE

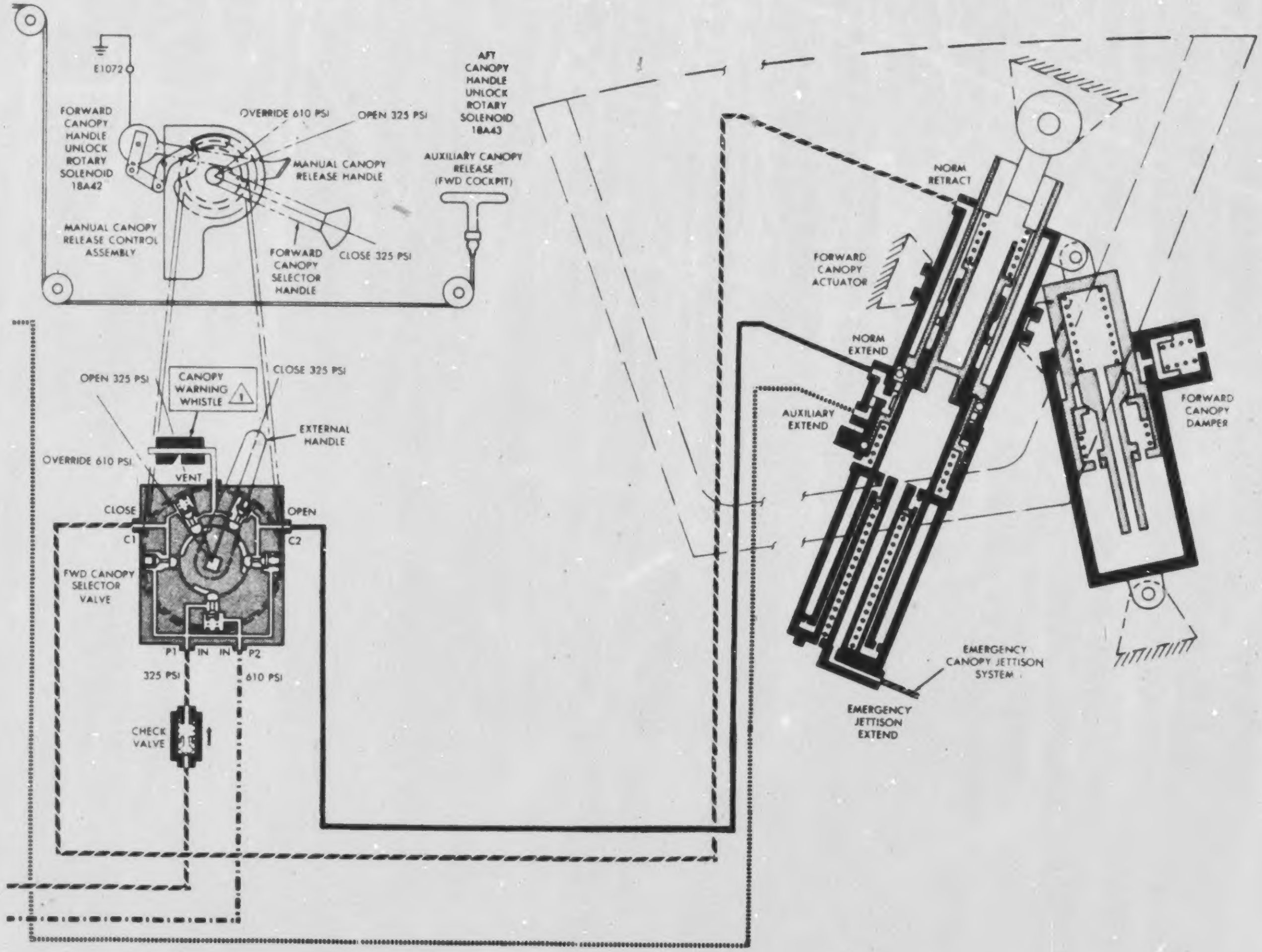
AM.644

Figure 8-7.—Canopy manual release system.


HIGH PRESSURE NITROGEN (2450 PSI MAX)
325 PSI AUXILIARY PRESSURE
325 PSI NORMAL PRESSURE
610 PSI OPEN OVERRIDE PRESSURE
325 PSI OR 610 PSI PRESSURE
VENT LINES
MECHANICAL CONNECTIONS
AUXILIARY CANOPY RELEASE (NOSE WHEEL WELL)
AIR RELEASE VALVE
RESTRICTOR
PRESSURE REDUCER 325 PSI OUTLET PRESSURE
IN
OUT
CHECK VALVE
RELIEF VALVE
CHECK VALVE
TO EMERGENCY JETTISON SYSTEM AIR BOTTLES
50 CUBIC INCH AUXILIARY RELEASE AIR BOTTLE
CHECK VALVE
TO LANDING GEAR EMERGENCY AIR BOTTLES
FORWARD COCKPIT NORMAL CANOPY SYSTEM AIR PRESSURE GAUGE
CANOPY JETTISON AND AUXILIARY RELEASE AIR PRESSURE GAUGE
LANDING GEAR EMERGENCY AIR PRESSURE GAUGE
CANOPY NORMAL AIR PRESSURE GAUGE
PRESSURE REDUCER 325 PSI OUTLET PRESSURE
OUT
IN
CHECK VALVE
CHECK VALVE
CHECK VALVE
CHECK VALVE
RESTRICTOR
IN
OUT
CHECK VALVE
PRESSURE REDUCER 610 PSI OUTLET PRESSURE
CHECK VALVE
PRESSURE MODULE
FILTER
CHARGING VALVE
RELIEF VALVE
RELIEF VALVE R.P. 770 PSI F.F. 850 PSI
VENT
1300 CUBIC INCH NORMAL CANOPY SYSTEM AIR BOTTLE

AM.645

Figure 8-8.—Normal canopy system-schematic. (Sheet 1)


E1072
FORWARD CANOPY HANDLE UNLOCK ROTARY SOLENOID 18A42
OVERRIDE 610 PSI
OPEN 325 PSI
AFT CANOPY HANDLE UNLOCK ROTARY SOLENOID 18A43
MANUAL CANOPY RELEASE HANDLE
AUXILIARY CANOPY RELEASE (FWD COCKPIT)
MANUAL CANOPY RELEASE CONTROL ASSEMBLY
FORWARD CANOPY SELECTOR HANDLE
CLOSE 325 PSI
OPEN 325 PSI
CANOPY WARNING WHISTLE
CLOSE 325 PSI
EXTERNAL HANDLE
OVERRIDE 610 PSI
VENT
CLOSE
OPEN
C1
C2
FWD CANOPY SELECTOR VALVE
P1
IN
IN
P2
325 PSI
610 PSI
CHECK VALVE
NORM RETRACT
FORWARD CANOPY ACTUATOR
NORM EXTEND
AUXILIARY EXTEND
FORWARD CANOPY DAMPER
EMERGENCY CANOPY JETTISON SYSTEM
EMERGENCY JETTISON EXTEND

AM.647

Figure 8-8.—Normal canopy system-schematic. (Sheet 2)

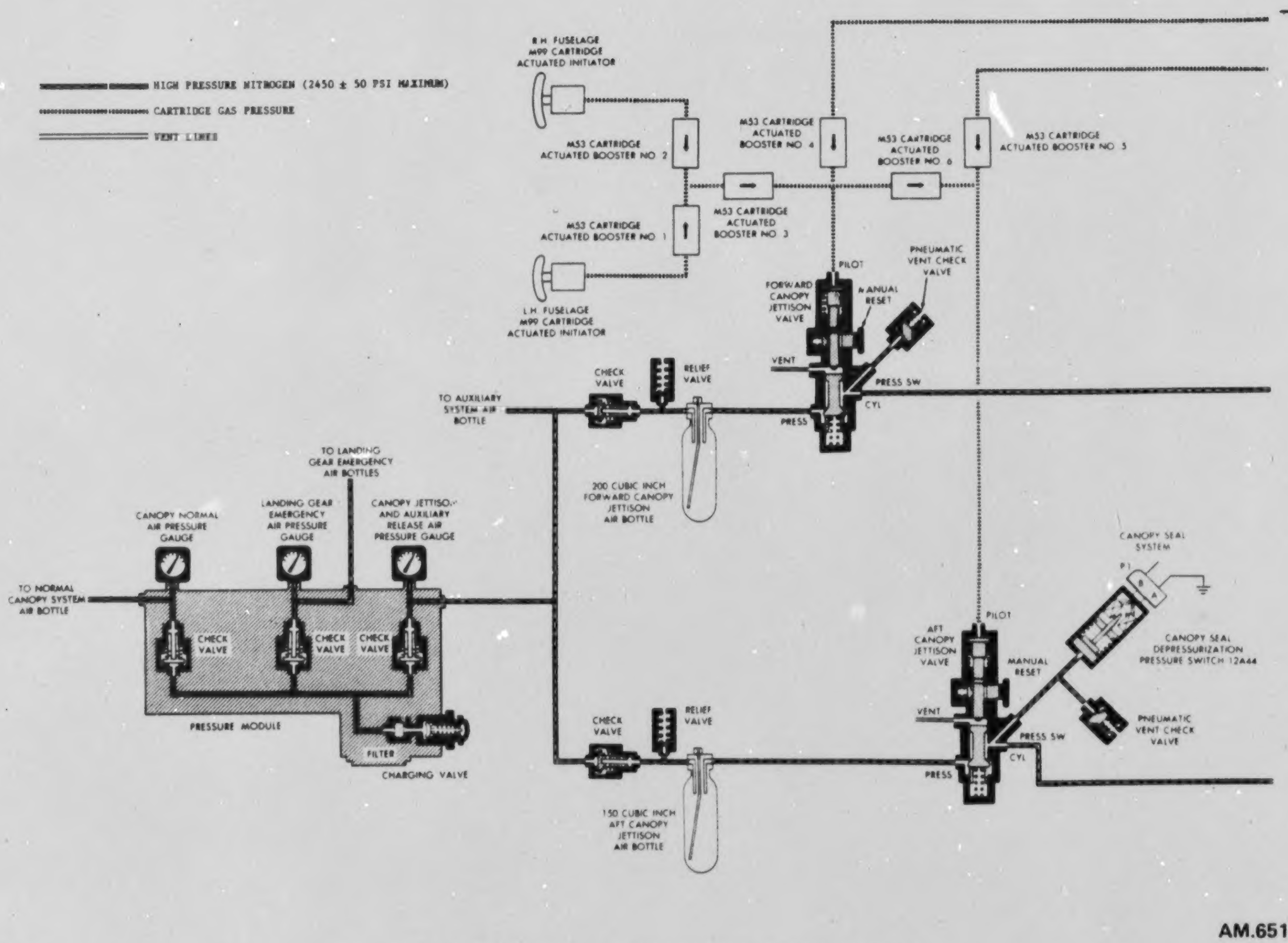
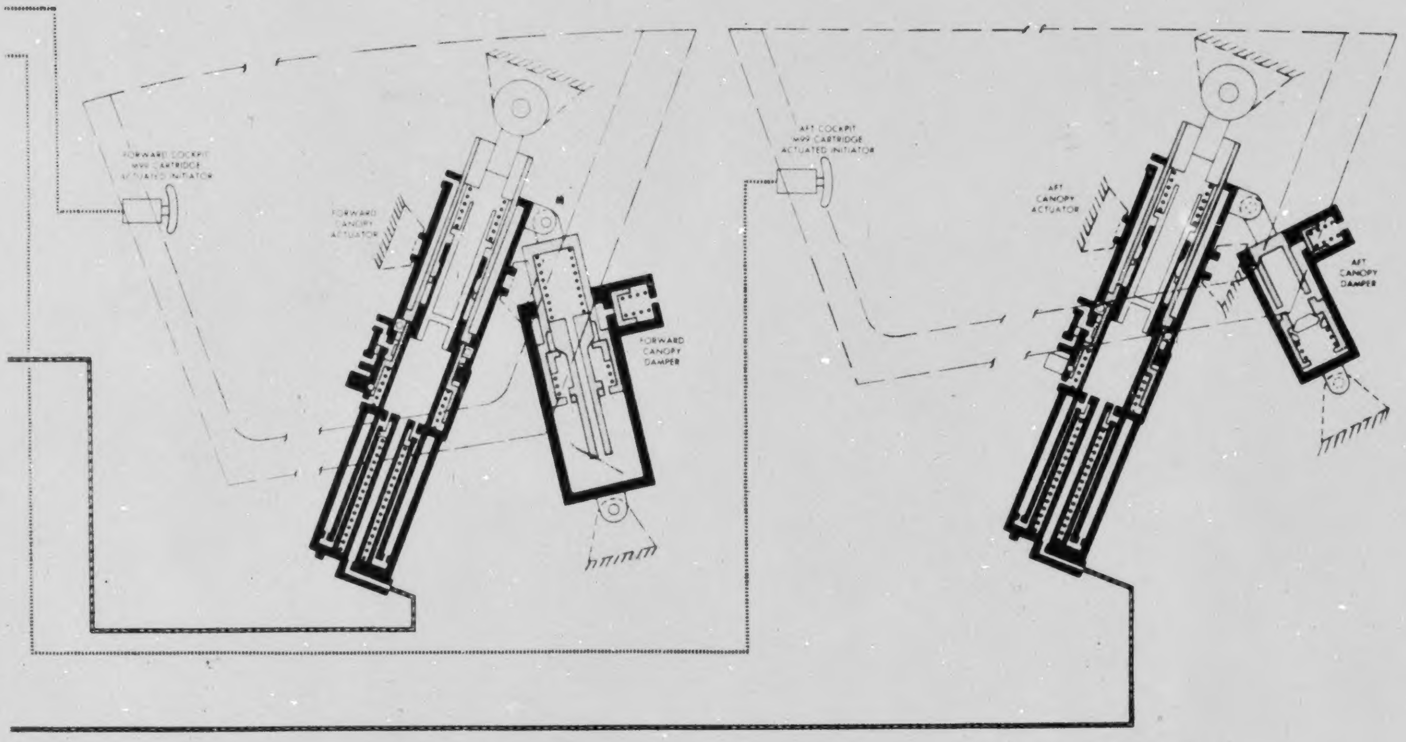

HIGH PRESSURE NITROGEN (2450 ± 50 PSI MAXIMUM)
CARTRIDGE GAS PRESSURE
VENT LINES
R.H. FUSELAGE M99 CARTRIDGE ACTUATED INITIATOR
M53 CARTRIDGE ACTUATED BOOSTER NO. 2
M53 CARTRIDGE ACTUATED BOOSTER NO. 1
L.H. FUSELAGE M99 CARTRIDGE ACTUATED INITIATOR
M53 CARTRIDGE ACTUATED BOOSTER NO. 4
M53 CARTRIDGE ACTUATED BOOSTER NO. 3
M53 CARTRIDGE ACTUATED BOOSTER NO. 6
M53 CARTRIDGE ACTUATED BOOSTER NO. 5
PILOT
FORWARD CANOPY JETTISON VALVE
MANUAL RESET
PNEUMATIC VENT CHECK VALVE
VENT
PRESS SW
CYL
PRESS
TO AUXILIARY SYSTEM AIR BOTTLE
CHECK VALVE
RELIEF VALVE
200 CUBIC INCH FORWARD CANOPY JETTISON AIR BOTTLE
TO LANDING GEAR EMERGENCY AIR BOTTLES
CANOPY NORMAL AIR PRESSURE GAUGE
LANDING GEAR EMERGENCY AIR PRESSURE GAUGE
CANOPY JETTISON AND AUXILIARY RELEASE AIR PRESSURE GAUGE
TO NORMAL CANOPY SYSTEM AIR BOTTLE
CHECK VALVE
CHECK VALVE
CHECK VALVE
PRESSURE MODULE
FILTER
CHARGING VALVE
CHECK VALVE
RELIEF VALVE
150 CUBIC INCH AFT CANOPY JETTISON AIR BOTTLE
CANOPY SEAL SYSTEM
P1
B
A
PILOT
AFT CANOPY JETTISON VALVE
MANUAL RESET
CANOPY SEAL DEPRESSURIZATION PRESSURE SWITCH 12A44
VENT
PRESS SW
CYL
PRESS
PNEUMATIC VENT CHECK VALVE
AM.651

Figure 8-9.—Emergency canopy jettison system-schematic (Sheet 1)


FORWARD COCKPIT
M99 CARTRIDGE
ACTUATED INITIATOR
FORWARD
CANOPY
ACTUATOR
FORWARD
CANOPY
DAMPER
AFT COCKPIT
M99 CARTRIDGE
ACTUATED INITIATOR
AFT
CANOPY
ACTUATOR
AFT
CANOPY
DAMPER

AM.653

Figure 8-9.–Emergency canopy jettison system-schematic (Sheet 2) cockpit. Since both canopies function in the same manner, only the operation of the forward canopy is described.

Operation of the canopy handle to the OPEN position moves the cables of the normal canopy cable system (fig. 8-11), causing the desired selection on the canopy selector valve.

The pressurized nitrogen forces the actuating cylinder piston to extend; the initial extension of the piston forces the actuating mechanism to move the canopy aft to the unlocked position, lighting the canopy lamp on the caution lights panel. (See fig. 8-12.)

The downward movement of the actuating cylinder stops, and the canopy is moved upward by the extending piston, until the fully opened position is reached. If the canopy fails to open fully, the canopy handle is moved to the spring-loaded OVERRIDE position; nitrogen pressurized to 610 psi is delivered to the open inlet port of the actuating cylinder.

To close the canopy, move the canopy handle to the CLOSE position. Nitrogen is delivered to the close inlet port of the actuating cylinder. The piston retracts and moves the canopy downward. This action continues until the canopy reaches its lowest point and is in the locked position; the canopy lamp then goes out to indicate that the canopy is in the closed position. (See fig. 8-12.)

Whenever the aircraft is airborne or its weight is off the wheels, both the forward and aft canopy handles are locked in the closed position by the energized canopy handle unlock solenoids, to prevent normal actuation of the canopy while airborne.

In the event that the canopies cannot be opened using the normal system, an auxiliary release system is provided. Pressurized nitrogen is provided from the 50 cubic-inch capacity auxiliary release air bottle by pulling the AUX CANOPY RELEASE handle on the pilot's lower instrument panel. (See fig. 8-13.) Nitrogen, pressurized to 325 psi, is then supplied to the forward and aft canopy actuating-cylinder auxiliary open inlet ports. The canopies are then opened in the same manner described in the preceding paragraph. After using the auxiliary system the canopies can be closed by resetting the air release valve, mounted on the air bottle. The canopy dampers control the rate of closing and the forward motion to the locked position will not occur without normal system pressure.

EMERGENCY JETTISON SYSTEM OPERATION

The emergency jettison system consists of M99 cartridge-actuated initiators, M53 cartridge-actuated boosters, forward and aft canopy jettison valves, air bottles, and actuating cylinders. (See figs. 8-14, 8-15, and 8-16.)

Operation of either of the external handles (fig. 8-17 (C)) or the handle in the forward cockpit (fig. 8-17 (A)) jettisons both canopies. Actuation of the handles will actuate the M99 initiator which releases a high-pressure gas that fires the M53 boosters. The pressure enters the PILOT port of the forward and aft jettison valves, opening them. Pressurized nitrogen from the forward and the aft canopy air bottle is then routed through the jettison valves to the jettison inlet ports of the forward and aft canopy actuators. Operation of the aft canopy handle (fig. 8-17 (B)) jettisons the aft canopy only. Refer to figure 8-8 for the sequence of events during jettison.

CANOPY SYSTEM MAINTENANCE

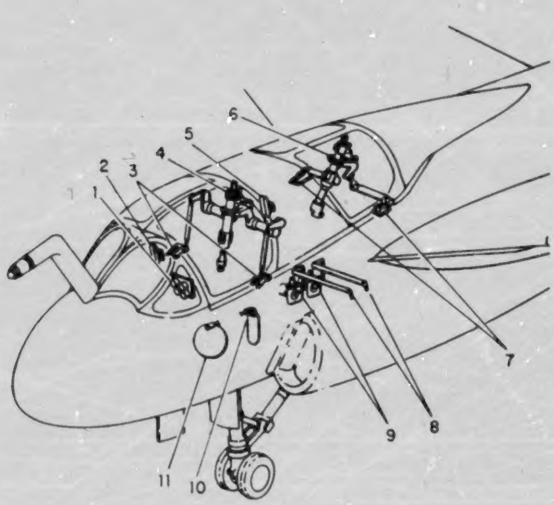
Before performing maintenance on the system, maintenance personnel should be familiar with the general maintenance procedures and safety precautions contained in Section IV, of the applicable MIM's.

Normal Canopy System Check

To perform a check on the normal canopy system, proceed as follows:

WARNING: Do not stand up in the cockpit while operating the canopy. During closing of the canopy, keep hands and arms clear of the canopy, windshield bow, fuselage longeron rails, and actuating assemblies.

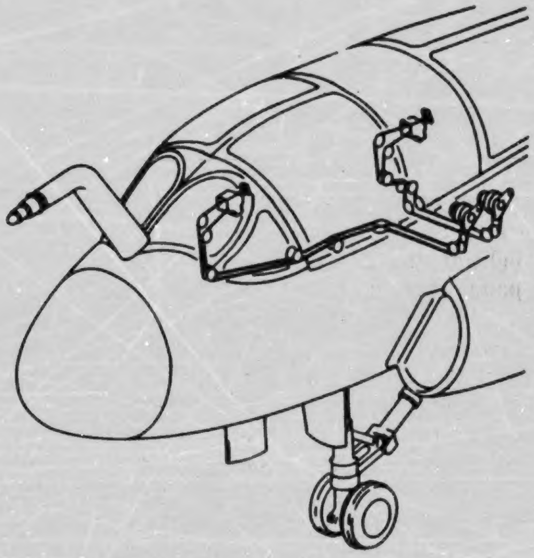
Connect external electrical power to the aircraft, then move canopy selector valves for each cockpit to the OPEN position. Insure that the canopies have jury struts installed when opened. Install jettison handle safety pins in all



AM.147

1. Auxiliary canopy release handle.
2. Forward canopy handle.
3. Forward canopy actuating mechanism.
4. Forward canopy actuating cylinder.
5. Aft canopy handle.
6. Aft canopy actuating cylinder.
7. Aft canopy actuating mechanism.
8. Forward and aft canopy handles (external).
9. Forward and aft selector valves.
10. Auxiliary release air bottle.
11. Normal system air bottle.

Figure 8-10.–Normal canopy system components.



AM.662

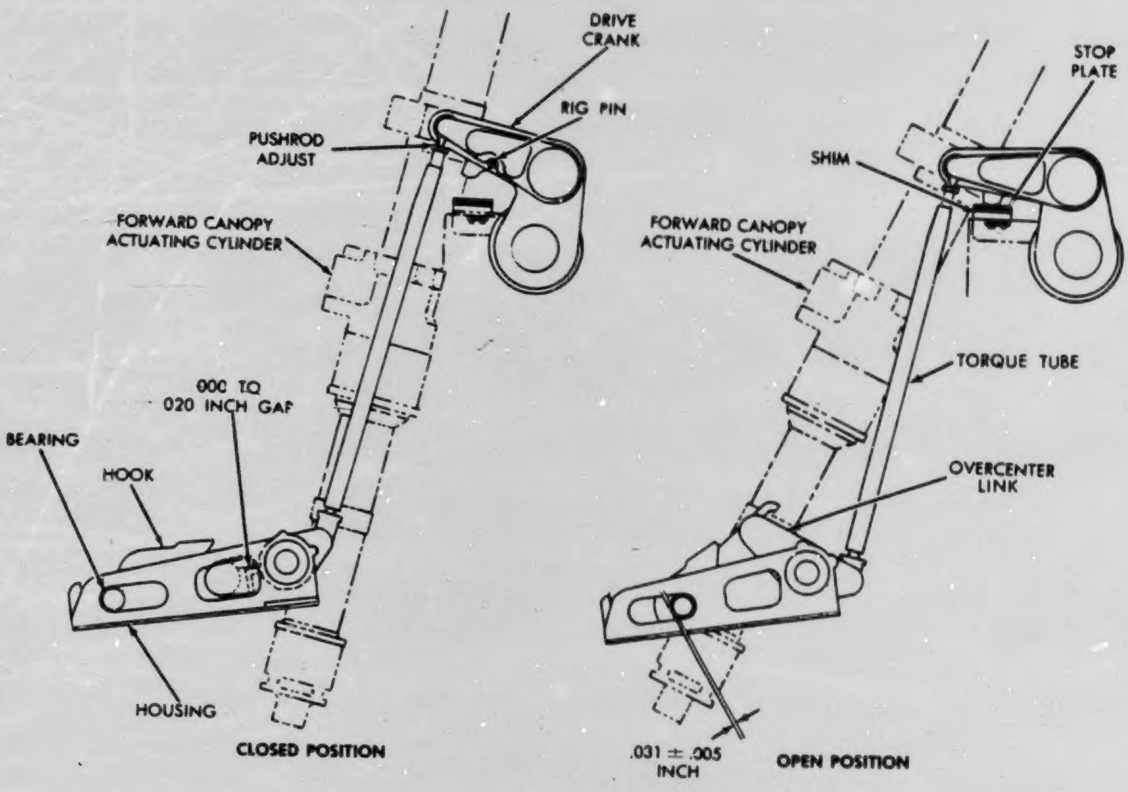
Figure 8-11.–Normal canopy cable system.

jettison control handles. Next connect the nitrogen bottle on the trailer to the charging valve and charge the aircraft's bottle. Remove the jury struts and proceed to the operational check.

To check operation, remove the manual control handle lock safety pin and move the canopy selector handle in the forward cockpit to the CLOSE position. Canopy should close fully without hesitation. Canopy light on the caution light panel should go out. Inspect all connections for leakage. Use the same procedure to check the OPEN cycle. To check OPEN OVERRIDE position, close the canopy. Move the canopy selector to the OPEN OVERRIDE position. Canopy should fully open without hesitation and the canopy light on caution light panel should come on.

Follow the same procedure for checking the rear canopy. When the aft canopy has been checked, activate both canopy selector handles to CLOSE positions to close canopies.

To check the auxiliary system pull the AUXILIARY CANOPY RELEASE handle in the forward cockpit. Both canopies should open without hesitation. Canopy light on caution light panel should light. Check all connections for leaks. Install jury struts and secure with safety pins. Install canopy manual control handle lock safety pins in both cockpit control handles and recharge air bottles through charging valve to 2,450±50 psi.


DRIVE CRANK
RIG PIN
PUSHROD ADJUST
FORWARD CANOPY ACTUATING CYLINDER
000 TO 020 INCH GAP
BEARING
HOOK
HOUSING
CLOSED POSITION
STOP PLATE
SHIM
FORWARD CANOPY ACTUATING CYLINDER
TORQUE TUBE
OVERCENTER LINK
.031 ± .005 INCH
OPEN POSITION

AM.663

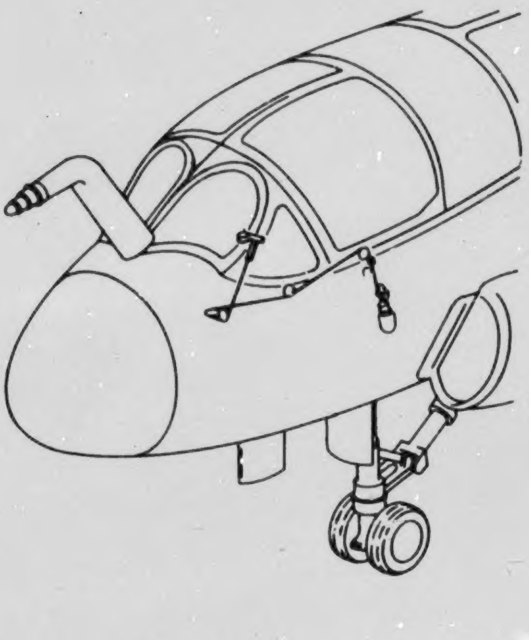
Figure 8-12.—Forward canopy actuating mechanism.

Emergency System Operational Check

The following procedure is followed in performing an operational check of the canopy emergency jettison system.

With the canopies open, install safety pins in initiator handles. Disconnect jettison lines from the forward and aft canopy actuator assemblies and install MS2806-T7 pneumatic pressure gages in lines, then disconnect inlet cartridge gas line from jettison valve and cap the fittings and line. Connect nitrogen bottle on the trailer to filler valve and charge bottles to 1,750 ±50 psi. Connect an external nitrogen supply bottle to jettison valves. Open nitrogen supply bottles connected to jettison valves, gradually increase pressure until jettison valves open. Nitrogen from the air bottles is now released to gages by way of the jettison valves. Insure that the pressure on the gages is at least 1,000 psi.

Bleed the jettison valves and lines, and manually reset jettison valve via MANUAL RELEASE. Remove the nitrogen supply and gages from the jettison lines and connect jettison lines to jettison ports of actuator assemblies.



AM.664

Figure 8-13.—Auxiliary release cable assembly.

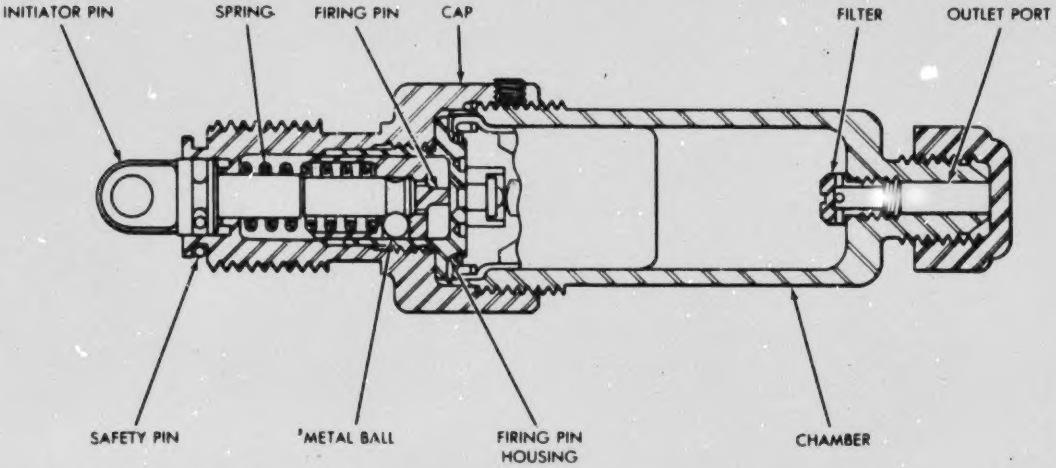
Charge jettison bottles from nitrogen bottle on trailer to 2,450 ±50 psi. Disconnect nitrogen trailer and install filler valve cap.

HYDRAULICALLY OPERATED CANOPY

A typical example of a hydraulically operated canopy is the A-6A sliding canopy system. Normal and manual operations are accomplished hydraulically while pneumatic pressure is used for emergency jettison. Figure 8-19 is the canopy system schematic for the A-6A. Frequent reference should be made to this schematic during study of this sytem operation.

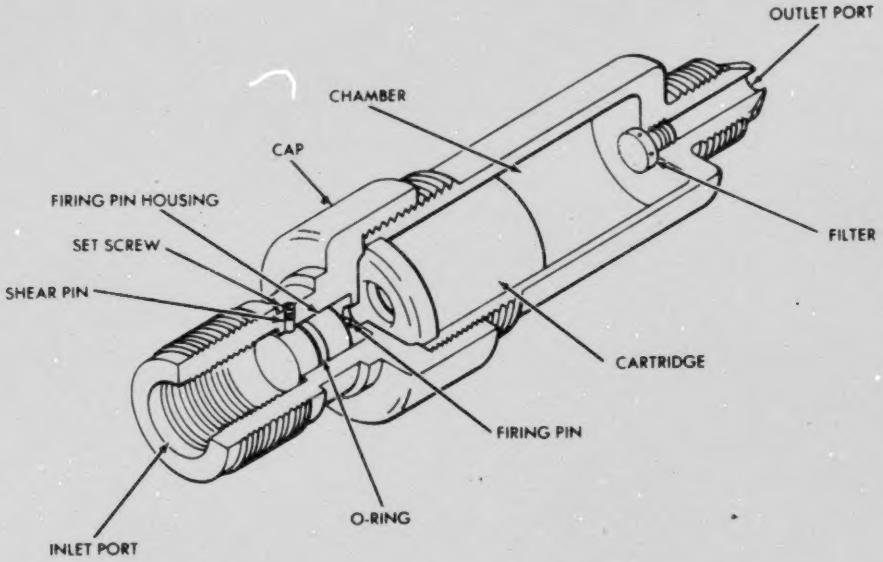
NORMAL SYSTEM OPERATION

Hydraulic power is provided by the combined hydraulic power system for normal operation of this canopy system. Hydraulic flow to open or close the canopy is controlled through the selector valve in the nosewheel well. The selector valve may be actuated either electrically or



AM.668

Figure 8-14.—M99 cartridge-actuated initiator-sectional.



AM.669

Figure 8-15.—M53 cartridge-actuated booster.

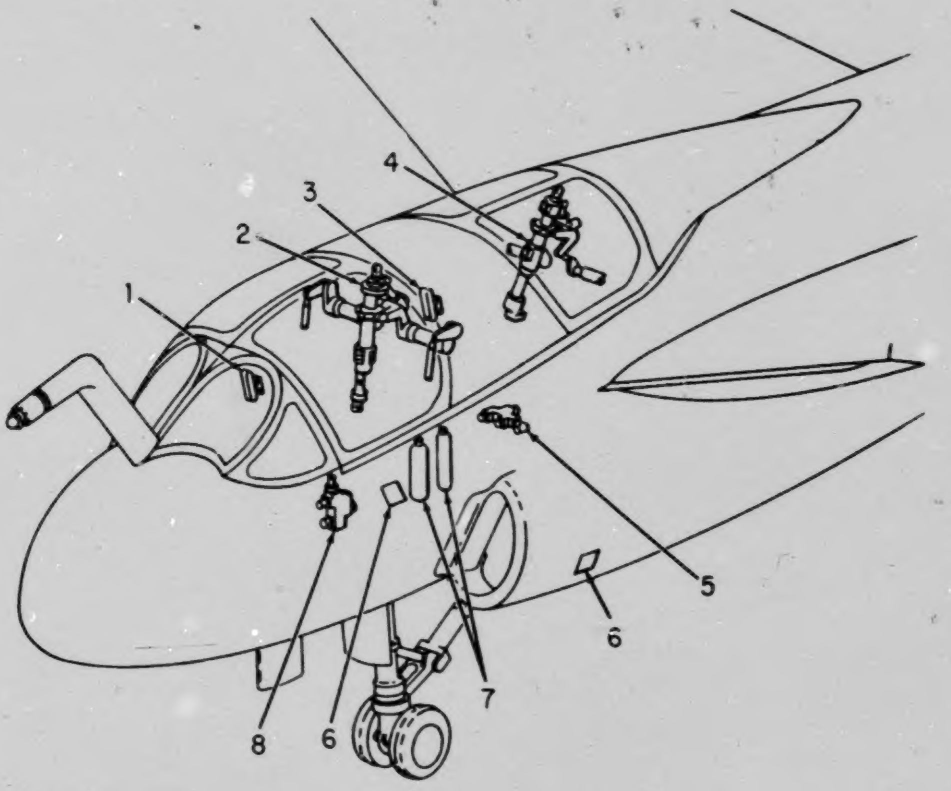
manually. The canopy system is normally operated by the canopy switch in the cockpit, which controls the selector valve, directing fluid flow to the canopy actuating cylinder, whenever the engines are operating, or external electrical, hydraulic, or pneumatic power is applied to the aircraft.

EMERGENCY SYSTEM OPERATION

Emergency jettison of the canopy can be initiated by either of three controls: JETTISON PULL handle control in the cockpit, and a RESCUE handle on each engine air intake duct. When either of these controls is actuated, a line is opened from a precharged bottle to the pneumatically fired cartridge on the back head end of the canopy cylinder. Three pneumatic air release valves (one actuated from the cockpit, the other two by their respective rescue handle on the engine air intake ducts) prevent the pressurized nitrogen from reaching the jettison cartridge. Opening any air release valve permits the pressurized nitrogen to reach the canopy actuator cap assembly and fire the jettison cartridge. A vent bleeder check valve, downstream of the air release valves, vents any low-pressure nitrogen that may have leaked past the air release valves. If any of the three air release valves is actuated, the bleeder valve stops venting.

MANUAL SYSTEM OPERATION

The hand pump system can also be used to manually pump the canopy into position when combined hydraulic system power is not available. The hand pump, located in the nosewheel well, is part of the auxiliary hydraulic power system, and can be operated from there or from the cockpit. The canopy selector valve can be manually actuated either from the cockpit or



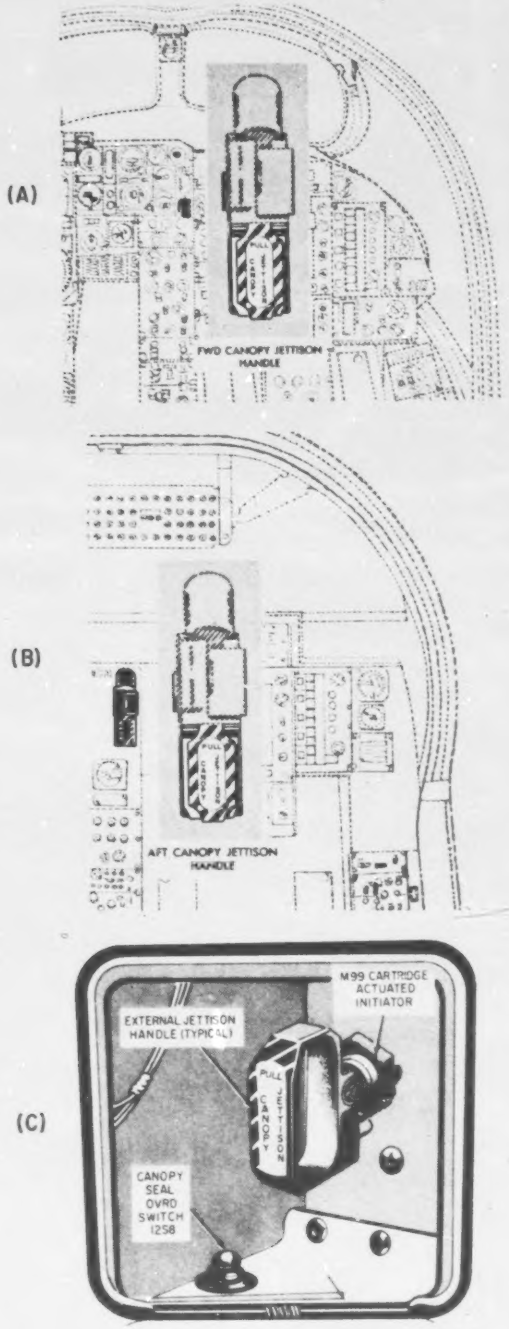
1. FWD canopy jettison handle.
2. FWD canopy actuating cylinder.
3. AFT canopy jettison handle.
4. AFT canopy actuating cylinder.
5. AFT canopy jettison valve, M53 booster, canopy depressurization switch and vent check valve.
6. External jettison handle, M99 cartridge actuated initiator, canopy seal OVRD switch (one each side of A/C.)
7. FWD/AFT canopy jettison bottles.
8. FWD canopy jettison valve, vent check valves, and manual release.

Figure 8-16.–Emergency canopy jettison system, component location.

nosewheel well and directs fluid flow to the actuating cylinder to open or close the canopy.

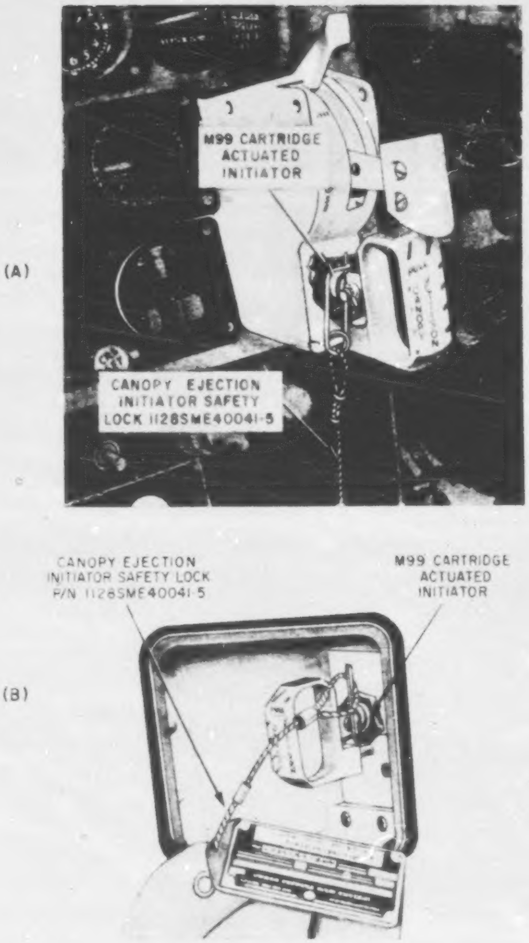
Manual release of the canopy from the canopy hydraulic cylinder is provided for canopy removal. Handles for manual release are inside the top of the canopy aft of the windshield arch and on the aft end of the canopy shell, underneath two canopy manual release access doors.

The handle inside the top of the canopy is covered by a guard to prevent the use of the handle as a handhold. To actuate the handle, the


(A)
PULL
CANOPY
JETTISON
FWD CANOPY JETTISON HANDLE
(B)
PULL
CANOPY
JETTISON
AFT CANOPY JETTISON HANDLE
(C)
M99 CARTRIDGE ACTUATED INITIATOR
EXTERNAL JETTISON HANDLE (TYPICAL)
PULL
CANOPY
JETTISON
CANOPY SEAL OVRD SWITCH 12S8

AM.671

Figure 8-17.—FWD & aft and external canopy jettison handles.


(A)
M99 CARTRIDGE ACTUATED INITIATOR
CANOPY EJECTION INITIATOR SAFETY LOCK 1128SME40041-5
(B)
CANOPY EJECTION INITIATOR SAFETY LOCK P/N 1128SME40041-5
M99 CARTRIDGE ACTUATED INITIATOR

AM.673

Figure 8-18.–**Jettison handle safety pins (installed).**

guard must be moved down and forward, then the release-handle moved down and aft.

Manual release of the canopy cannot be accomplished when the canopy seal is pressurized.

CANOPY SYSTEM MAINTENANCE

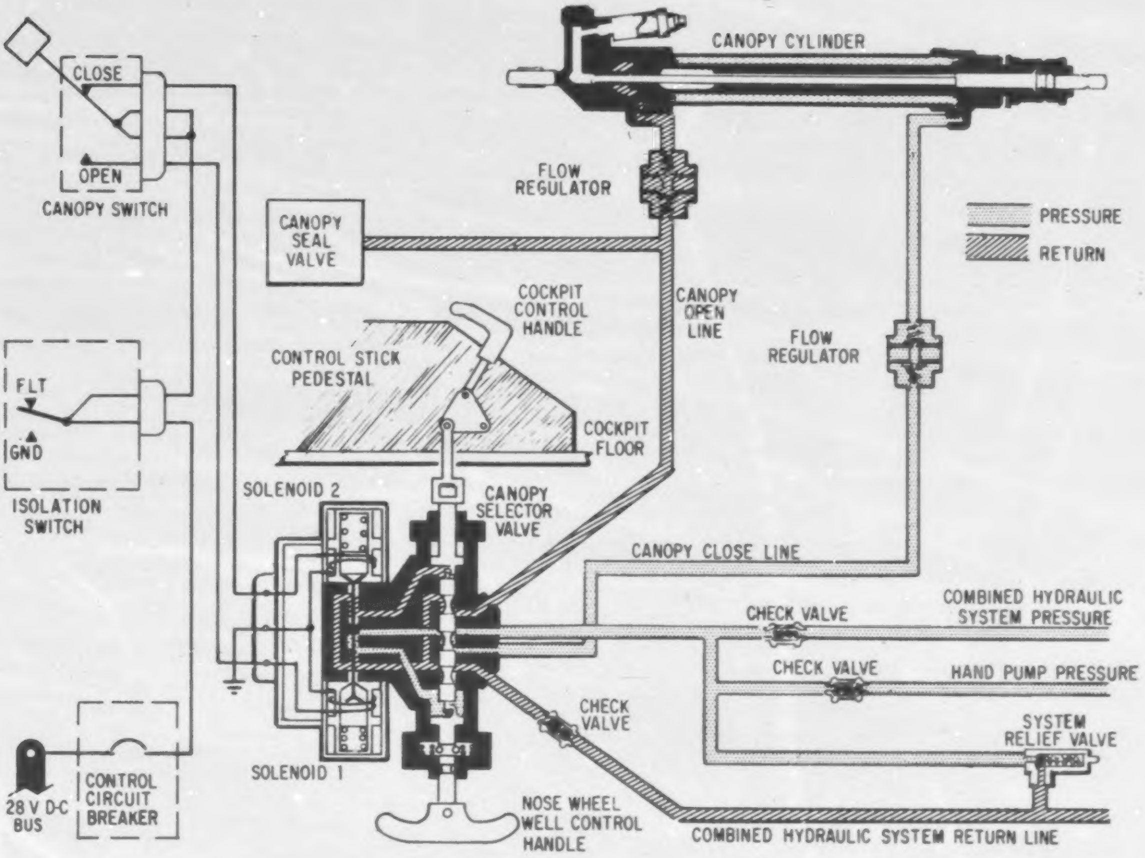
Maintenance of the hydraulically operated canopy system consists mainly of servicing, operational checks, and troubleshooting. Maintenance Instructions Manuals and MRC's for the specific aircraft list in detail the step-by-step procedures that are to be followed and used while performing operational checks and servicing. Troubleshooting charts, schematic diagrams, drawings, and tables are also included to help the AME in diagnosing malfunctions, isolating defective parts, and determining the correct procedures for repair or replacement. Warnings, notes of caution, and safety are stressed throughout the Maintenance Instructions Manuals and are to be strictly adhered to.

CANOPY THERMAL RADIATION CLOSURES

Canopy thermal radiation closures protect the pilot and cockpit from both heat and light of nuclear explosions. The same closure, for training purposes, may also be used as an instrument flying hood. The thermal radiation closure is presently incorporated in some of the Navy's aircraft; i.e., A-7A and A-4E. Operation of the closure is manual in the A-4E aircraft while in the A-7A the closure may be extended or retracted manually or pneumatically. The pneumatic operation may be selected by placing the thermal closure 3-way switch in the CLOSE or AUTO position.

DESCRIPTION

The thermal radiation closure installed in the A-7A consists of one fixed and three movable segments (panels) which enclose the entire cockpit when in the extended position (closed) as illustrated in figure 8-20. Each segment is constructed of laminations of glass cloth impregnated with pigmented polyester resin. The outer surface of each segment is painted a glossy white, and the inside, a flat, nonreflective black. Also, to provide positive elimination of light when the closure is actuated to the extended position, high-temperature-resistant silicone rubber seals are installed at all closure mating points.



CLOSE
OPEN
CANOPY SWITCH
CANOPY CYLINDER
FLOW REGULATOR
CANOPY SEAL VALVE
PRESSURE
RETURN
COCKPIT CONTROL HANDLE
CANOPY OPEN LINE
CONTROL STICK PEDESTAL
FLOW REGULATOR
FLT
GND
ISOLATION SWITCH
COCKPIT FLOOR
SOLENOID 2
CANOPY SELECTOR VALVE
CANOPY CLOSE LINE
COMBINED HYDRAULIC SYSTEM PRESSURE
CHECK VALVE
CHECK VALVE
HAND PUMP PRESSURE
CHECK VALVE
SYSTEM RELIEF VALVE
SOLENOID 1
28 V D-C BUS
CONTROL CIRCUIT BREAKER
NOSE WHEEL WELL CONTROL HANDLE
COMBINED HYDRAULIC SYSTEM RETURN LINE

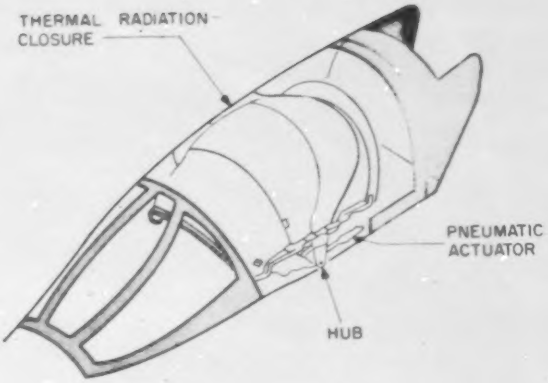
AM.145

Figure 8-19.—Canopy system schematic.

The three movable segments are formed to seat within the fourth, which is permanently attached to the aft part of the canopy. The three segments have a hub assembly riveted to each side to make a pivot point about which each segment rotates. In addition, the inner segment has provisions for attachment of pneumatic closure actuators and two angles riveted near the forward edge to be used as handles to manually actuate the closure.

As the closure travels to the extended position, manually or pneumatically, a flange on each segment engages a matching flange on the leading edge of the next larger segment. This action causes the adjoining segments to be pulled along until all movable segments have been fully rotated to their extended position, while an overcenter device, on each side of the closure, assures smooth operation and maintains the closure in its extended or retracted (closed) position by exerting a force up to 20 pounds.

In the retracted position, the movable segments retract within the contour of the fixed segment; therefore, the segments do not restrict vision of performance of normal and emergency operations.



AM.643

Figure 8-20.—A-7A thermal radiation closure.

OPERATION

The thermal radiation closure may be operated by moving the thermal closure control switch to the CLOSE position; consequently this action connects a power source to the ejection seat position switch. If the ejection seat is positioned higher than 1.5 inches above its full down position, the seat position switch, through its relay and seat actuator, lowers the seat to provide clearance for the closure.

When the seat reaches 1.5 inches above its full down travel, the seat position switch is actuated by the seat to deenergize the relay, thus stopping the seat. The actuated seat position switch connects an electric power source to the selector valve solenoid of the closure; thus completing the ground circuit for the valve through closed contacts of the thermal control switch, and the valve is actuated.

The actuated selector valve connects pneumatic system pressure at 1,000 psi through a restrictor to the two closure actuators, rapidly extending the closure (0.2 second). The control switch is spring loaded to OFF when it is released from the CLOSED position, disconnecting power to the selector valve solenoid. When deenergized, the selector valve blocks pneumatic pressure to the actuators and vents them, allowing the closure to be manually retracted or extended when desired.

Placing the thermal closure control switch in AUTO connects and electrical power source to the selector valve solenoid, as in the CLOSE position, through the seat position switch which automatically lowers the seat before connecting power to the closure selector valve solenoid. In AUTO, however, the solenoid is not connected to ground through the thermal closure control switch as it is in the CLOSE position. To actuate the selector valve and extend the closure in AUTO, the solenoid must be connected to ground by a switch in the switching/demodulator unit.

The switch in the switching/demodulator unit connects the solenoid to ground and energizes the selector valve for about 3 seconds when the switch is actuated by the nuclear flash sensor on the pilot's helmet. After 3 seconds, the selector valve is deenergized and the closure actuators are vented, allowing the closure to be manually opened. The nuclear flash sensor is activated by high intensity light such as that from a nuclear explosion.

When activated, the sensor applies an electrical pulse to both the switching/demodulator unit and the lens on the pilot's helmet through a trigger unit attached to the left-hand side of the pilot's flight clothing. The trigger unit increases the electrical output directed to the lens which is required to detonate the small explosive charge contained in the lens. The charge, when exploded, releases a light-blocking suspension of graphite from the lens to protect the pilot's eyes from the thermal flash.

In addition, in the AUTO position, when the selector valve solenoid is actuated, the cockpit white floodlights are energized to full bright and the red floodlights are turned off.

EJECTION SEATS

There are several configurations of the various types of ejection seats use; in naval aircraft. To discuss all of them would be impractical, so only the Martin-Baker Rocket Assist H-7, ESCAPAC IE, and NORTH AMERICAN HS-1 are covered in this chapter.

MARTIN-BAKER ROCKET ASSIST EJECTION SEAT (H-7)

The H-7 seat is a rocket assist ejection seat that provides support and the necessary environmental equipment for the crewmembers during flight, and a means of fast, safe escape during emergency flight conditions. The seat assembly incorporates features permitting ejection at ground level, zero airspeed, as well as during emergency flight conditions.

Description

The basic structure of the seat is the main beam assembly, which is built to withstand high g-loads, support all of the components, and form the main framework for the seat.

The basic components of the seat assembly include a catapult gun, a gas powered inertia reel, a rocket motor, seat bucket assembly, and survival equipment. Figure 8-21 shows the Martin-Baker rocket assist ejection seat. Frequent reference should be made to it while studying the H-7 seat.

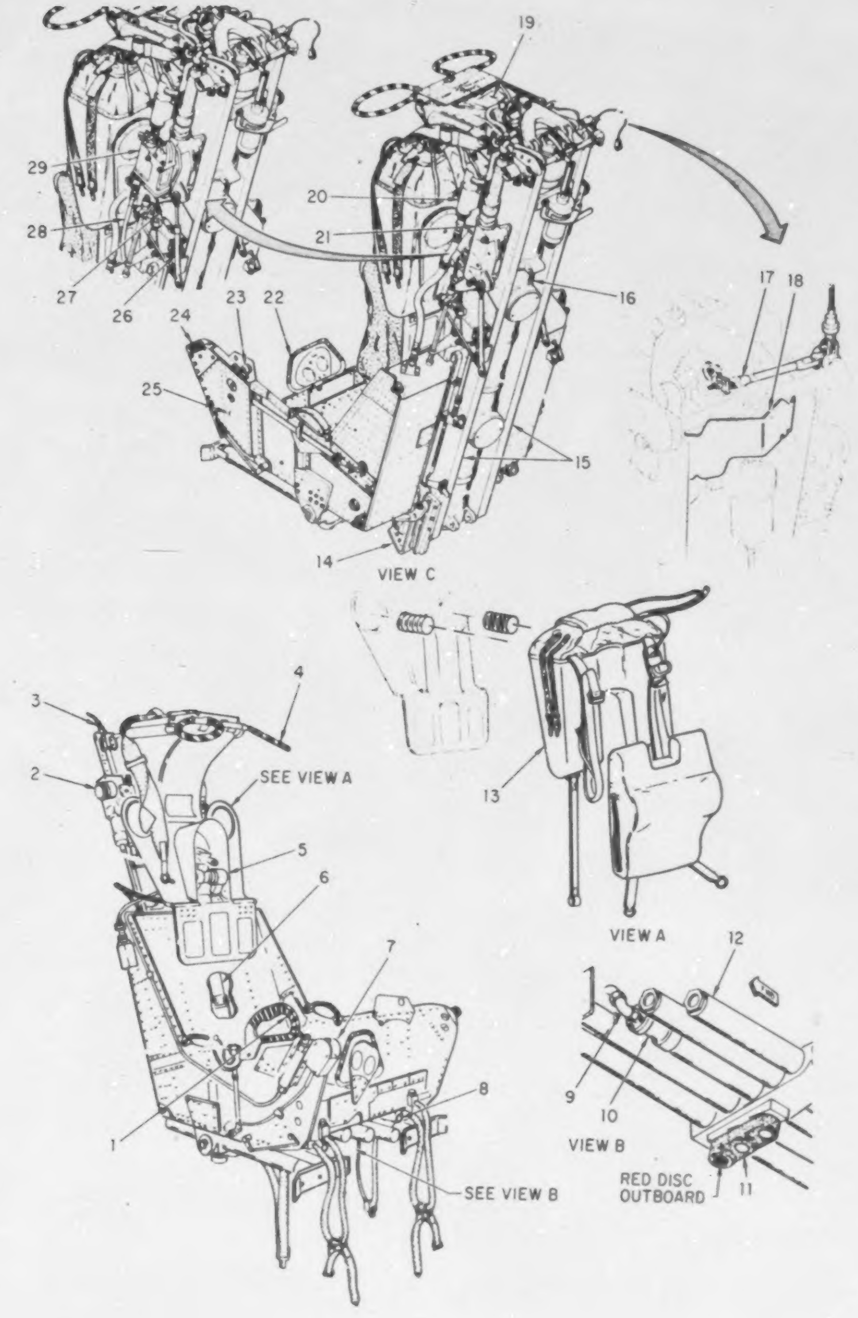
The catapult gun is composed of four major assemblies–the firing mechanism, inner barrel, intermediate barrel, and outer barrel, and provides the initial forces required to eject the seat from the aircraft; and the rocket motor creates additional thrust during the ejection sequence, catapulting the seat and occupant to a safe recovery altitude.

The inertia reel prevents rapid forward movement of the seat occupant during deceleration crash forces or violent maneuvers, and positions and restrains the occupant's upper torso during the ejection sequence. The personnel parachute is automatically deployed after ejection, separating the occupant from the seat for a safe descent.

The seat is equipped with two separate ejection control handles, either of which may be used to initiate the ejection sequence. These two controls are the face curtain and the secondary ejection handle. The face curtain, located above the occupant's head, provides face protection and promotes proper ejection posture during the ejection sequence. The secondary ejection handle, located between the crewmember's knees on the seat bucket, is the alternate method of firing the seat when the face curtain cannot be reached.

NOMENCLATURE FOR FIGURE 8-21.

1. **Emergency harness release handle.**
2. **Time release mechanism.**
3. **Canopy interlock block.**
4. **Face curtain handle.**
5. **Gas powered inertia reel.**
6. **Seat bucket positioning actuator.**
7. **Seat bucket positioning switch.**
8. **Leg restraint snubber finger ring.**
9. **Rocket motor initiator hose.**
10. **Rocket motor firing body.**
11. **Rocket nozzles protective covers.**
12. **Rocket motor.**
13. **Personnel parachute.**
14. **Seat bucket guide track.**
15. **Main beam assembly.**
16. **Catapult gun.**
17. **Canopy interlock block and catapult gun firing mechanism.**
18. **Firing mechanism guard (Aft seat).**
19. **Drogue parachutes.**
20. **Guillotine knife blade assembly.**
21. **Drogue gun.**
22. **Secondary ejection handle.**
23. **Shoulder harness manual control handle.**
24. **Leg restraint manual release handle.**
25. **Seat bucket.**
26. **Drogue gun trip rod.**
27. **Rocket motor initiator firing lanyard.**
28. **Rocket motor initiator hose.**
29. **Rocket motor initiator.**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VIEW B
SEE VIEW B
RED DISC
OUTBOARD
11

AM.675

Figure 8-21.–Rocket assist ejection seat.

Mounted on each side of the seat near the top are the drogue gun and time release mechanism. Automatic operation of the seat is dependent upon these two units. They are equipped with trip rods that pull the sears from the units during upward travel of the seat, thus actuating the operating mechanism of each unit.

The drogue gun deploys the drogue parachutes, which stabilize and decelerate the seat. The time release mechanism automatically releases the seat occupant from the seat, freeing the drogue chutes, which delay the personnel parachute.

The seat is linked to the canopy by the canopy interlock mechanism, which is mounted across the top of the main beam assembly. (See fig. 8-22.) This mechanism is used to provide proper sequencing between the canopy and ejection seat during ejection and also transmits the force of the face curtain handle or secondary ejection handle to the seat mounted initiator and catapult gun firing mechanism. A combined canopy interlock block and catapult gun firing mechanism (interdictor) safety pin assembly is installed in the interlock mechanism. The (interdictor) safety pin safeties the catapult gun firing mechanism during aircraft ground maintenance and remains installed during flight to protect the firing mechanism from inadvertent actuation. The interlock block segment is connected to the canopy by a cable and is pulled from the seat interlock mechanism by the canopy during the ejection sequence which also pulls the (interdictor) safety pin from the catapult gun firing mechanism.

Seat bucket features include stowage for the survival kit; an emergency harness release handle that permits manual release of the occupant's harness during manual separation procedures; a shoulder harness manual control handle that permits manual locking and unlocking of the inertia reel, thereby controlling movement of the harness loop straps; a leg restraint manual release handle that permits manual release of the leg restraint cord lockpins; and two finger rings that permit manual adjustment of the leg restraint cords.

Operation

The operation of the rocket assist ejection seat consists of two phases–normal and emergency. Normal operation of the seat consists of controlling shoulder movement, seat bucket positioning, leg restraint cord adjustment, and manual release of leg restraint cords.

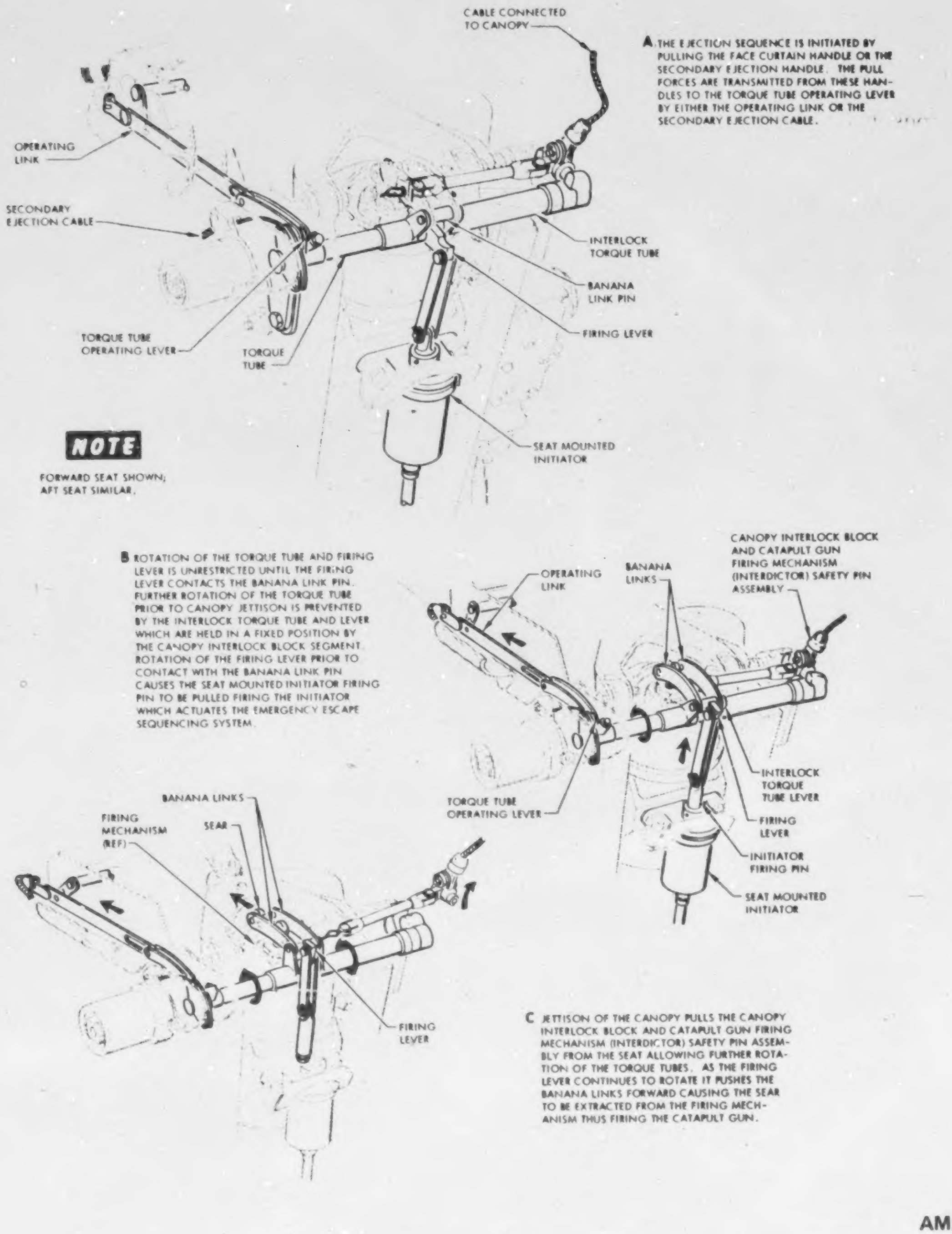
Shoulder movement is controlled by the shoulder harness manual control handle. Mechanical linkage between the handle and the gas powered inertia reel permits manual locking and unlocking of the reel, which allows the two harness loop straps on the reel to extend and retract, permitting normal movement of the seat occupant.

Rapid forward shoulder movement is automatically prevented by the inertia reel. When forward motion of the seat occupant causes the harness loop straps to unwind from the inertia reel faster than a safe predetermined rate of speed, the inertia reel lock mechanism senses the excessive strap velocity and automatically locks the reel until tension is released from loop straps; the inertia reel automatically unlocks.

Seat bucket positioning is controlled by actuating the seat bucket positioning switch on the seat bucket. Up and down travel is limited by limit switches located within the seat bucket positioning actuator.

Leg restraint cord adjustment is controlled by the leg restraint snubbing box finger rings. When pulled forward, these rings allow the leg restraint cords to be pulled through the snubbing boxes of the seat and thus provide cord length as desired. Manual release of the leg restraint cords is controlled by the leg restraint manual release handle. When pulled aft, this handle causes mechanical linkage to release the leg restraint cord lockpins from the seat locking mechanisms and releases the occupant's legs from the seat.

Emergency operation of the seat includes events that occur during the ejection sequence. This sequence begins with the actuation of either the face curtain handle or the secondary ejection handle, which casuses the seat mounted initiator to fire and continues until a safe parachute descent of the crewmember is accomplished.


CABLE CONNECTED TO CANOPY
OPERATING LINK
SECONDARY EJECTION CABLE
INTERLOCK TORQUE TUBE
BANANA LINK PIN
FIRING LEVER
TORQUE TUBE OPERATING LEVER
TORQUE TUBE
SEAT MOUNTED INITIATOR
OPERATING LINK
BANANA LINKS
CANOPY INTERLOCK BLOCK AND CATAPULT GUN FIRING MECHANISM (INTERDICTOR) SAFETY PIN ASSEMBLY
INTERLOCK TORQUE TUBE LEVER
TORQUE TUBE OPERATING LEVER
FIRING LEVER
INITIATOR FIRING PIN
SEAT MOUNTED INITIATOR
BANANA LINKS
FIRING MECHANISM (REF)
SEAR
FIRING LEVER

A THE EJECTION SEQUENCE IS INITIATED BY PULLING THE FACE CURTAIN HANDLE OR THE SECONDARY EJECTION HANDLE. THE PULL FORCES ARE TRANSMITTED FROM THESE HANDLES TO THE TORQUE TUBE OPERATING LEVER BY EITHER THE OPERATING LINK OR THE SECONDARY EJECTION CABLE.

NOTE

FORWARD SEAT SHOWN; AFT SEAT SIMILAR.

B ROTATION OF THE TORQUE TUBE AND FIRING LEVER IS UNRESTRICTED UNTIL THE FIRING LEVER CONTACTS THE BANANA LINK PIN. FURTHER ROTATION OF THE TORQUE TUBE PRIOR TO CANOPY JETTISON IS PREVENTED BY THE INTERLOCK TORQUE TUBE AND LEVER WHICH ARE HELD IN A FIXED POSITION BY THE CANOPY INTERLOCK BLOCK SEGMENT. ROTATION OF THE FIRING LEVER PRIOR TO CONTACT WITH THE BANANA LINK PIN CAUSES THE SEAT MOUNTED INITIATOR FIRING PIN TO BE PULLED FIRING THE INITIATOR WHICH ACTUATES THE EMERGENCY ESCAPE SEQUENCING SYSTEM.

C JETTISON OF THE CANOPY PULLS THE CANOPY INTERLOCK BLOCK AND CATAPULT GUN FIRING MECHANISM (INTERDICTOR) SAFETY PIN ASSEMBLY FROM THE SEAT ALLOWING FURTHER ROTATION OF THE TORQUE TUBES. AS THE FIRING LEVER CONTINUES TO ROTATE IT PUSHES THE BANANA LINKS FORWARD CAUSING THE SEAR TO BE EXTRACTED FROM THE FIRING MECHANISM THUS FIRING THE CATAPULT GUN.

AM.676

Figure 8-22.—Canopy interlock mechanism.

The ejection may be either single (one seat) or dual (forward and aft seats). When pilot initiated, ejection is dual (unless the aft seat has already been ejected). The aft seat occupant may select dual (in the event the pilot is injured and cannot eject himself) or single ejection.

NOTE: Whenever dual ejection is selected, whether it be initiated from the forward or aft cockpit, the aft canopy and ejection seat will always be the first to jettison and eject.

During dual ejection, pulling either the face curtain or the secondary ejection handle initiates the dual ejection sequence system, which provides fast, sequenced ejection of the canopies and ejection seats. No further action is required by either crewmember during the remainder of the sequence.

After ejection, automatic separation of the seat and occupant should occur. If it does not, due to a malfunction of the seat mechanism, manual override of the seat mechanism by the occupant is necessary in order to accomplish a safe parachute descent.

The emergency harness release handle must be pulled. This releases all personnel restraints and personnel parachute restraints, and the occupant must then push himself free of the seat and manually pull the parachute D-ring.

In addition to the high speed/high altitude ejection, the rocket thrust phase successfully accomplishes ejection at zero speed/zero altitude, permitting occupant and seat to be catapulted to a sufficient height to enable full deployment of the parachute before returning to ground level.

As the inner and intermediate barrels of the catapult gun extend upward, the inner barrel actuates the top latch mechanism, unlocking the seat from the catapult gun outer barrel. Continued upward movement of the inner barrel propels the seat up the tracks of the catapult gun and fires the auxiliary cartridges as they become exposed to the hot propellant gases within the gun.

Staggered firing of the auxiliary cartridges furnishes relatively even gas pressures within the gun, eliminating high acceleration forces during ejection.

During upward travel of the seat, trip rods pull the sears of the drogue gun and time release mechanism, initiating the time sequence of the drogue gun. The time release mechanism assumes the ready condition, which will subsequently actuate the time release mechanism within safe altitude limits for the seat occupant.

Continued upward movement of the seat will cause the rocket motor to ignite triggered by a lanyard (fig. 8-21, item 27) attached to the rocket motor firing mechanism. The lanyard unwinds as the seat raises and pulls the sear from the rocket motor initiator (Fig. 8-21, item 29) when fully extended. As the initiator fires, the gases are transmitted to the rocket motor through the initiator bore (fig. 8-23, items 28 and 29) firing the rocket motor and providing additional thrust to the seat ejection.

The seat and inner barrel separation from the gun occurs when the inner and intermediate barrels are fully extended in the outer barrel, and the seat continues its upward travel by momentum of the seat mass.

The drogue gun fires and deploys the drogue parachutes, approximately one second after initiation. This stabilizes and decelerates the seat. At high altitudes the drogue parachutes stabilize the descent until a safe altitude limit for the seat occupant is reached. At this altitude the time release mechanism initiates a time delay sequence.

The time release mechanism actuates approximately 2.25 seconds after initiation, releasing the drogue parachutes, leg restraints, shoulder harness, lap belt, and personnel parachute restraints from the seat and face curtain.

NOTE: The g-controller has been deleted from the H-7 ejection seat.

The personnel parachute is linked to the drogue parachutes by a withdrawal line, which is pulled when the drogue parachutes are released from the seat, deploying the personnel parachute.

The opening shock of the personnel parachute separates the occupant from the seat and a normal parachute descent follows.

Zero speed/zero altitude, or low level ejection is basically the same as high altitude ejection except for operation of the time release mechanism.

Component Maintenance

The information discussed in this section is confined to the limits of maintenance, if any, which current directives permit Organizational and Intermediate level maintenance activities to accomplish on the components of the Martin-Baker ejection seat.

The AME is responsible for inspecting, testing, and adjusting ejection seat firing mechanisms as well as the removal and replacement of cartridges. Although some steps in maintenance procedures outlined in Maintenance Instructions Manuals may seem repetitious, they are necessary to insure correct installation of components. Therefore, it is mandatory to follow the step-by-step procedures outlined in the applicable manuals.

Information found in this chapter represents a typical installation and must not be used in place of the applicable Maintenance Instructions Manual.

NOTE: The ejection seat has several inherently dangerous features which are a definite hazard to uninformed and/or careless personnel. Consequently, whenever the aircraft is on the ground, all safety pins must be installed as shown in figure 8-23 and not removed until the aircraft is ready for flight.

Caution must be observed at all times during maintenance of and around the seat(s) to avoid injury and equipment damage by explosive components of the seat. Safety precautions and correct procedures cannot be overemphasized.

CATAPULT GUN FIRING MECHANISM.—The firing mechanism, illustrated in figure 8-24, screws into the primary cartridge breech of the inner barrel and seats on the top of the primary cartridge. The mechanism contains a simple spring-loaded firing pin that is operated by a sear. Further descriptive information on this component may be found in the Aviation Structural Mechanic E3 & 2, NavTra 10309-C training manual.

Removal and installation of Firing Mechanism and Cartridges. Following the step-by-step procedures outlined in the applicable Maintenance Instructions Manual, the AME begins removal of the firing mechanism by first insuring that all seat safety pins are installed. Insure interdictor safety pin assembly is installed as shown in view A of figure 8-25.

Carefully pull canopy interlock block portion of the interdictor assembly out of the seat interlock mechanism making sure the interdictor safety pin is not removed from the sear. (View B.) Using both hands, carefully remove the interdictor safety pin from the sear with one hand and install a safety pin in the sear with the other. (Views C and D.) Now carefully press forward on the sear and disconnect the banana links as shown in view E, and remove safety pin from sear. Install AN3-3A bolt through the safety pin hole and install AN315-3 nut as in view F. Cut and remove lockwire from the firing mechanism body, inner barrel retainer, and primary cartridge breech. (View F.) Using the torque wrench adapter and flexible hinge handle remove the primary firing mechanism by turning mechanism counterclockwise. (View G.)

WARNING: To prevent injury or death, do not drop cartridge when removing, as a percussion primer can fire.

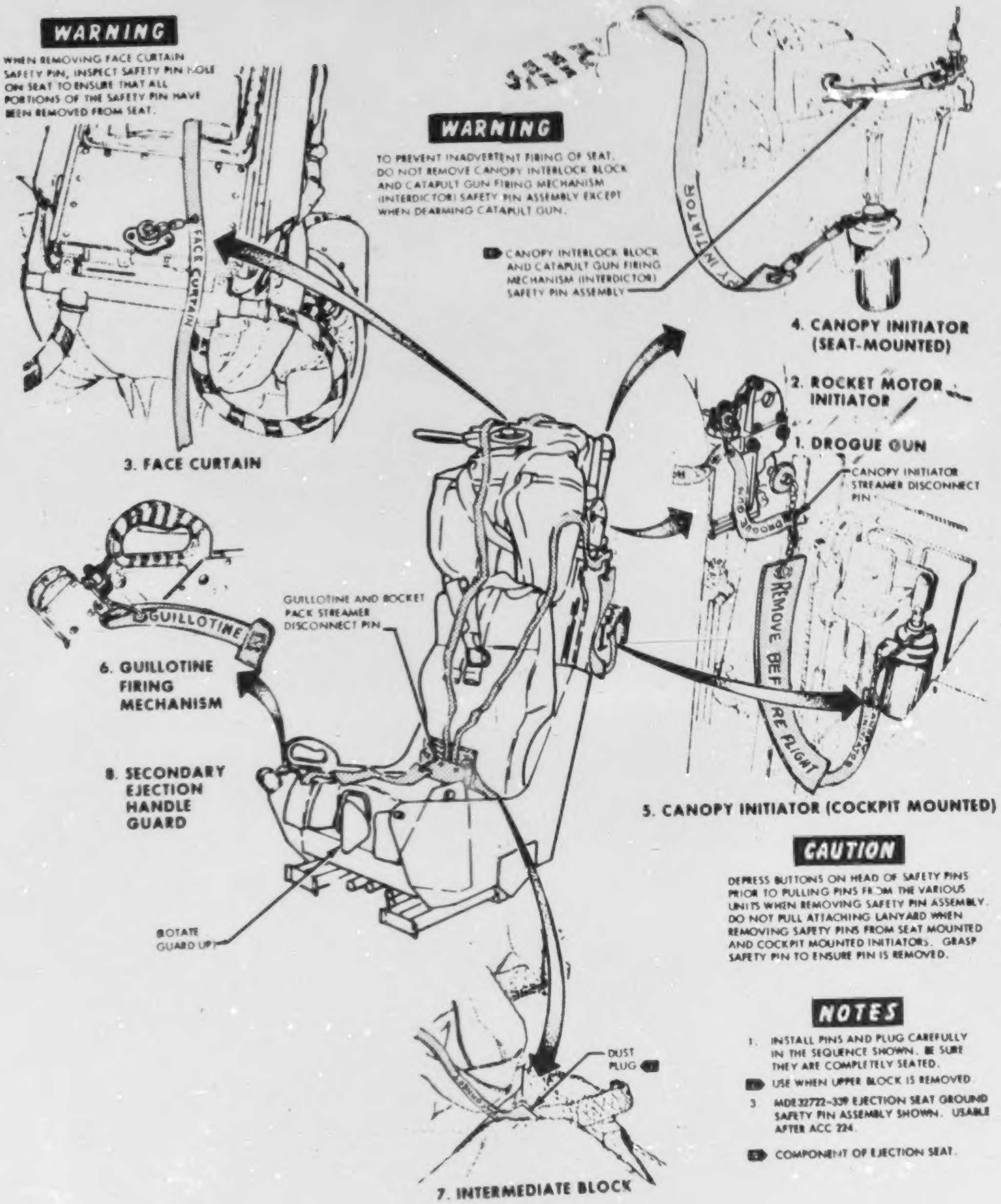
Carefully remove the cartridge from the breech using a cartridge extraction tool.

NOTE: The extractor tool is essentially a suction cup affixed to the end of a metal rod. Raise the cartridge up from its seat only far enough to secure a handhold on it. This will eliminate the possibility of the cartridge falling off the tool after it is completely removed.

(View H) After removal, place the cartridge in cartridge block, then record the position of the seat (forward or aft cockpit) and aircraft serial number on the cartridge block data card, then place block in a suitable metal container for storage. To prevent contamination of the gun, place the inner barrel retainer on the primary firing mechanism and install firing mechanism fingertight in the breech.

CAUTION: To prevent damage to the canopy and links, banana links must be rotated forward before canopy is closed.

Prior to installation of the cartridge and firing mechanism, the catapult gun's internal cavity is inspected for cleanliness and condition. Remove all water, oil, and other debris that may be present in the lower end of the catapult gun. Accumulation of any liquid in the gun seriously reduces the catapult gun forces during the ejection sequence. Also, inspect the catapult firing mechanism for corrosion, cleanliness, and condition of threads. Place the mechanism in a vise, as illustrated in figure 8-26, and lift the firing pin and remove the sear. There should be no binding or restriction felt in the movement of the firing pin or removal of the sear.


FACE CURTAIN
3. FACE CURTAIN
CANOPY INITIATOR
4. CANOPY INITIATOR (SEAT-MOUNTED)
2. ROCKET MOTOR INITIATOR
1. DROGUE GUN
CANOPY INITIATOR STREAMER DISCONNECT PIN
DROGUE GUN
REMOVE BEFORE FLIGHT
GUILLOTINE
6. GUILLOTINE FIRING MECHANISM
GUILLOTINE AND ROCKET PACK STREAMER DISCONNECT PIN
8. SECONDARY EJECTION HANDLE GUARD
ROTATE GUARD UP
5. CANOPY INITIATOR (COCKPIT MOUNTED)
DUST PLUG
7. INTERMEDIATE BLOCK

WARNING

WHEN REMOVING FACE CURTAIN SAFETY PIN, INSPECT SAFETY PIN HOLE ON SEAT TO ENSURE THAT ALL PORTIONS OF THE SAFETY PIN HAVE BEEN REMOVED FROM SEAT.

WARNING

TO PREVENT INADVERTENT FIRING OF SEAT, DO NOT REMOVE CANOPY INTERLOCK BLOCK AND CATAPULT GUN FIRING MECHANISM (INTERDICTOR) SAFETY PIN ASSEMBLY EXCEPT WHEN DEARMING CATAPULT GUN.

CANOPY INTERLOCK BLOCK AND CATAPULT GUN FIRING MECHANISM (INTERDICTOR) SAFETY PIN ASSEMBLY

CAUTION

DEPRESS BUTTONS ON HEAD OF SAFETY PINS PRIOR TO PULLING PINS FROM THE VARIOUS UNITS WHEN REMOVING SAFETY PIN ASSEMBLY. DO NOT PULL ATTACHING LANYARD WHEN REMOVING SAFETY PINS FROM SEAT MOUNTED AND COCKPIT MOUNTED INITIATORS. GRASP SAFETY PIN TO ENSURE PIN IS REMOVED.

NOTES

1. INSTALL PINS AND PLUG CAREFULLY IN THE SEQUENCE SHOWN. BE SURE THEY ARE COMPLETELY SEATED.
USE WHEN UPPER BLOCK IS REMOVED.
3. MDE32722-339 EJECTION SEAT GROUND SAFETY PIN ASSEMBLY SHOWN. USABLE AFTER ACC 224.

COMPONENT OF EJECTION SEAT.

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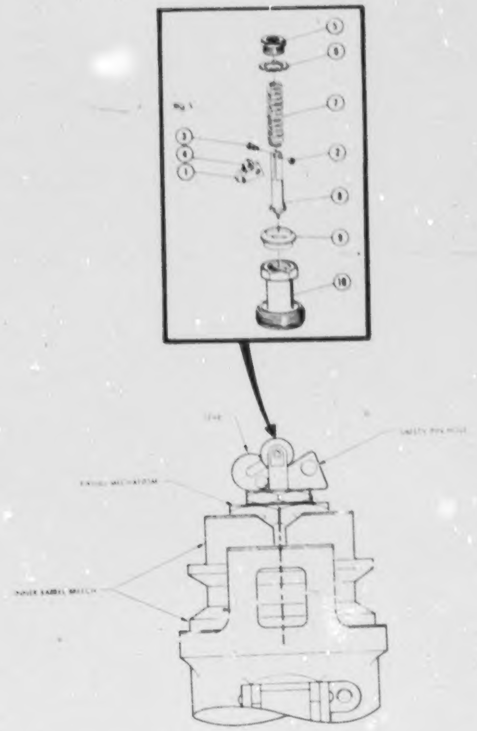
Figure 8-23.—Ground safety pins.



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1.	Sear.	6.	Washer (tab).
2.	Washer.	7.	Spring.
3.	Spindle.	8.	Firing pin.
4.	Roller.	9.	Dust seal.
5.	Nut.	10.	Body.

Figure 8-24.–Catapult gun firing mechanism.

With sear removed from mechanism, attach a spring scale to firing pin extractor tool and connect tool to firing pin. Pull upward on spring scale and observe reading on scale when firing pin starts to move.

RESULT: The force required to begin initial movement of firing pin must not be less than 8 pounds.

With firing pin protruding from the lower end of mechanism, measure pin protrusion with a depth micrometer. If either the spring scale test or the pin protrusion test is unsatisfactory, the firing mechanism should be forwarded to the local supply for proper disposition.

When these checks are completed, lift the firing pin and install the sear in the firing mechanism. Make certain that the firing pin is not protruding with the sear installed and that all of the prussian blue stains have been removed from the bottom of the firing mechanism.

To install the cartridge. remove the cartridge from the cartridge block and check the cartridge expiration date. Insure that the original cartridge is installed in the same catapult by checking the aircraft serial number and seat location recorded on the cartridge block data card. Clean all the prussian blue stains, if any, from the base of the cartridge with acetone and install the cartridge seal. The cartridge is then inserted into the breech of the catapult gun.

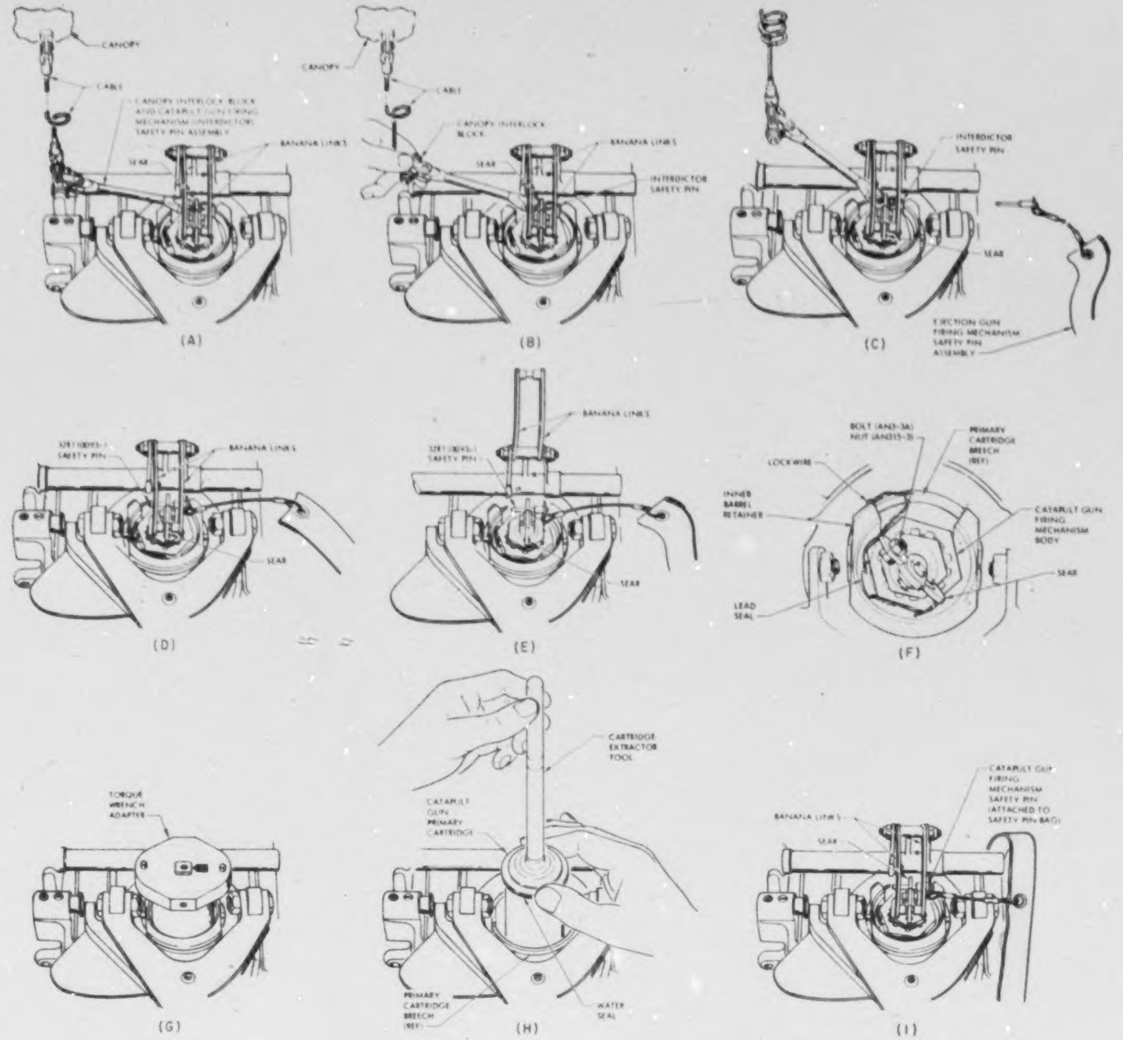
Apply a thin coat of prussian blue to the bottom of the firing mechanism body and insure that the firing pin is not protruding from the base of the firing mechanism.

CAUTION: If the pin is protruding, firing of the cartridge will occur when the firing mechanism is installed.

Carefully install the firing mechanism, including the inner barrel retainer and water seal in the breech. Insure the threads are properly engaged and then tighten the firing mechanism to the required torque specified in the applicable Maintenance Instructions Manual. This is accomplished with the aid of a special torque wrench adapter. (See fig. 8-25(G).)

After torquing the firing mechanism, place a pencil mark on its large hex nut and another one adjacent to it on the breech. Remove the firing mechanism from the breech, counting the number of turns required for removal. Record the number of turns. Check the top of the cartridge for prussian blue which should have transferred from the firing mechanism to the top of the cartridge. If transfer does not occur, the firing mechanism has not bottomed on the cartridge. Steps must be taken to correct the discrepancy and all the preceding installation steps repeated.

After satisfactory accomplishment of the preceding steps, clean all the prussian blue stains from both the top of the cartridge and the base of the firing mechanism. Place the inner barrel retainer ring on the firing mechanism and

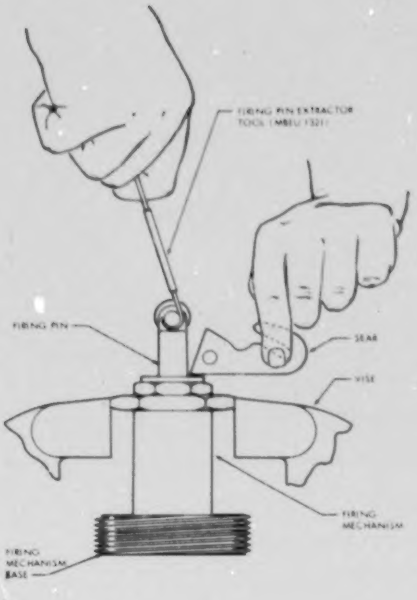

CANOPY
CABLE
CANOPY INTERLOCK BLOCK AND CATAPULT GUN FIRING MECHANISM (INTERDICTOR) SAFETY PIN ASSEMBLY
BANANA LINKS
SEAR
(A)
CANOPY
CABLE
CANOPY INTERLOCK BLOCK
BANANA LINKS
SEAR
INTERDICTOR SAFETY PIN
(B)
INTERDICTOR SAFETY PIN
SEAR
EJECTION GUN FIRING MECHANISM SAFETY PIN ASSEMBLY
(C)
3281100093-1 SAFETY PIN
BANANA LINKS
SEAR
(D)
BANANA LINKS
3281100093-1 SAFETY PIN
SEAR
(E)
BOLT (AN3-3A) NUT (AN315-3)
PRIMARY CARTRIDGE BREECH (REF)
LOCKWIRE
INNER BARREL RETAINER
CATAPULT GUN FIRING MECHANISM BODY
SEAR
LEAD SEAL
(F)
TORQUE WRENCH ADAPTER
(G)
CARTRIDGE EXTRACTOR TOOL
CATAPULT GUN PRIMARY CARTRIDGE
PRIMARY CARTRIDGE BREECH (REF)
WATER SEAL
(H)
CATAPULT GUN FIRING MECHANISM SAFETY PIN (ATTACHED TO SAFETY PIN BAG)
BANANA LINKS
SEAR
(I)

AM.680

Figure 8-25.—Catapult gun firing mechanism and primary cartridge removal and installation.

carefully reinstall the mechanism in the breech. Count the number of turns required to tighten the mechanism to the required torque and then check the alignment of the pencil marks on the firing mechanism. The pencil marks must be approximately in alignment and the number of turns required must be the same as those previously recorded.

When the firing mechanism is installed, remove the nut and bolt from the sear and install the ground safety pin in its place. Safety the firing mechanism and inner barrel retainer with lockwire to insure that components remain secure against vibrations. A lead seal is affixed to the lockwire to indicate that the device has been inspected and determined to be in a ready-for-



AM.648
Figure 8-26.–Sear installation and removal.

flight condition. (See fig. 8-27.) To be in a ready-for-flight condition, a cartridge actuating device must be armed, loaded, and properly assembled. In addition, an auxiliary function of the seal is to provide a means of identifying which activity and what personnel inspected and approved the device's condition for operational use.

Carefully press forward on the sear and connect the banana links to the sear. Then install the canopy interlock block.

Removal and Installation of Auxiliary Cartridges.–Auxiliary catapult gun cartridges are installed in the lower and midportion of the gun as shown in figure 8-27. These cartridges, although not the percussion primer type, should be handled with care.

The removal of the cartridges requires the catapult gun to be removed from the aircraft and placed in a vise. Insure gun clamp blocks are used while clamping the gun to prevent damage of the gun. (See fig. 8-28 (A).) The AME must remove both chamber caps, using a torque wrench adapter as shown in view (A), by turning them counterclockwise. The cartridges are removed from their cavities with the use of an extractor tool as shown in view (B)– discard the water seal.

Cartridges are inspected for expiration dates and the chamber caps are reinstalled fingertight to prevent contamination of the gun. The auxiliary cartridges are stored in the same manner as outlined for the primary cartridges.

To install the auxiliary cartridges, they must be inspected for the correct aircraft serial number and seat position. This is to insure that the original cartridge location is maintained. Prior to installation in the catapult gun, the cartridge expiration date is rechecked. The AME then removes the chamber caps and inspects the chamber for corrosion, obstructions, and general condition. After finding the chamber satisfactory, inspect the chamber caps and cartridges for cleanliness and freedom from foreign substances. Lubricate the new auxiliary cartridge seals with grease (MIL-G-23549) and install the seals in the chambers.

Auxiliary cartridges are supplied in sealed containers with plastic shipping discs between the cartridges. Prior to installation, insure that the plastic shipping discs have been removed from the cartridges. The cartridges are installed in such a manner to allow the igniter holes to face inward. The cartridge caps cannot be installed with the cartridge facing the wrong direction. The chamber caps are then put in place and tightened to a specified torque. Each cap is lockwired and lead sealed as illustrated in figure 8-27.

GUILLOTINE ASSEMBLY.–The guillotine assembly is a pyrotechnically operated device that is manually actuated and used to sever the personnel parachute withdrawal line during manual separation from the seat during crash rescue. Figure 8-29 illustrates the guillotine assembly operation.

Under normal ejection conditions, the withdrawal line is pulled from the knife blade assembly when the drogue parachute deploys the personnel parachute. During manual operation, the occupant must depress the lock lever to unlock the harness release handle and pull it aft.

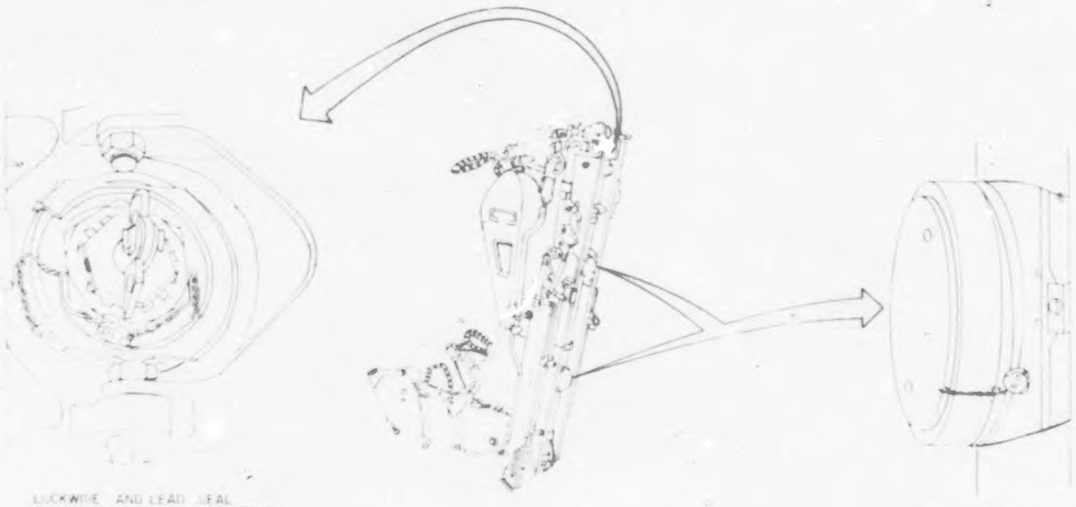


Figure 8-27.—Catapult gun lockwire and lead seal installation.

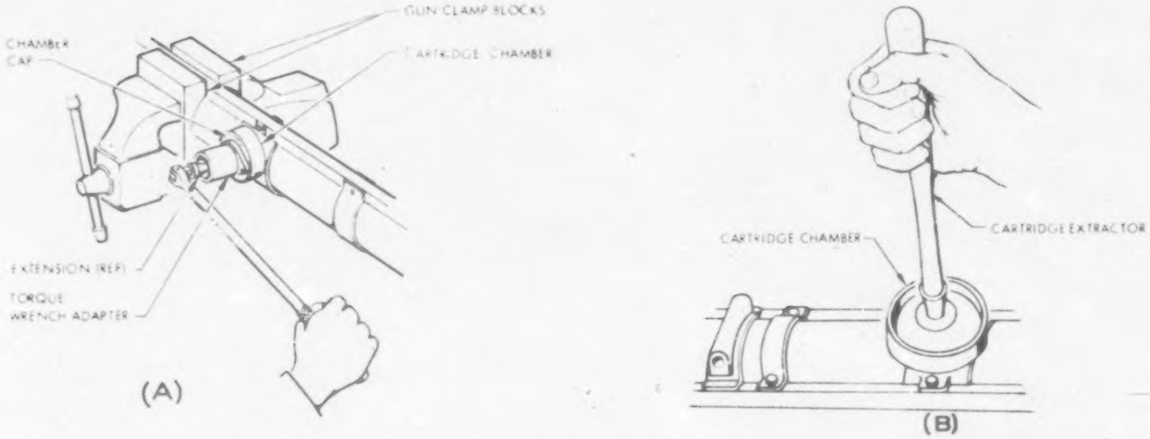
This extracts the sear from the firing pin in the firing mechanism. The firing pin strikes the percussion cap on the cartridge and gas pressure generated by the cartridge travels to the guillotine piston through connecting tubing. The gas pressure forces the guillotine piston, to which a knife blade is attached, up to sever the parachute withdrawal line. The occupant may then push free from the seat and pull the D-ring which deploys the personnel parachute for normal descent to the ground.

In addition to firing the guillotine, the emergency harness release handle releases the lap belts, harness loop straps, leg restraint cords, and personal parachute restraint straps through the emergency harness release linkage.

Removal and Installation of Guillotine Firing Mechanism and Cartridge.—The firing mechanism is removed by using specified procedures. First insure all pins of the ejection seat ground safety pin assembly are installed, and the secondary ejection handle guard is in the UP position, and locks are in release position to prevent release mechanism from reseating. Then cut and remove the lockwire between the firing mechanism and its housing. (See fig. 8-30 (A).)

NOTE: When removing lockwire and lead seals from a device, the lockwire must be CUT and not broken from the unit. Material damage to the component may occur by breaking the wire.

Secondly, disconnect the sear from the emergency harness release handle and then remove its safety pin. The pin is replaced with a nut and bolt, in the same manner as described for the catapult gun firing mechanism sear. Unscrew the firing mechanism and remove the mechanism and cartridge from the housing. If the cartridge remains in the housing, push the cartridge extractor tool, as illustrated in view (B), over the cartridge and remove the cartridge from the housing. Do not remove the cartridge by introducing objects into the tubing connection end of the firing mechanism housing. If the cartridge is jammed in the housing, move the cartridge extractor tool back and forth until the cartridge



AM.650

Figure 8-28.—Auxiliary cartridge removal.

is free of the housing. A cartridge that has been jammed must be disposed of in accordance with applicable procedures for unserviceable ammunition.

The removed serviceable cartridge is then placed in a cartridge block and the seat position and aircraft serial number recorded on the cartridge block data card. Reinstall the firing mechanism fingertight to prevent contamination.

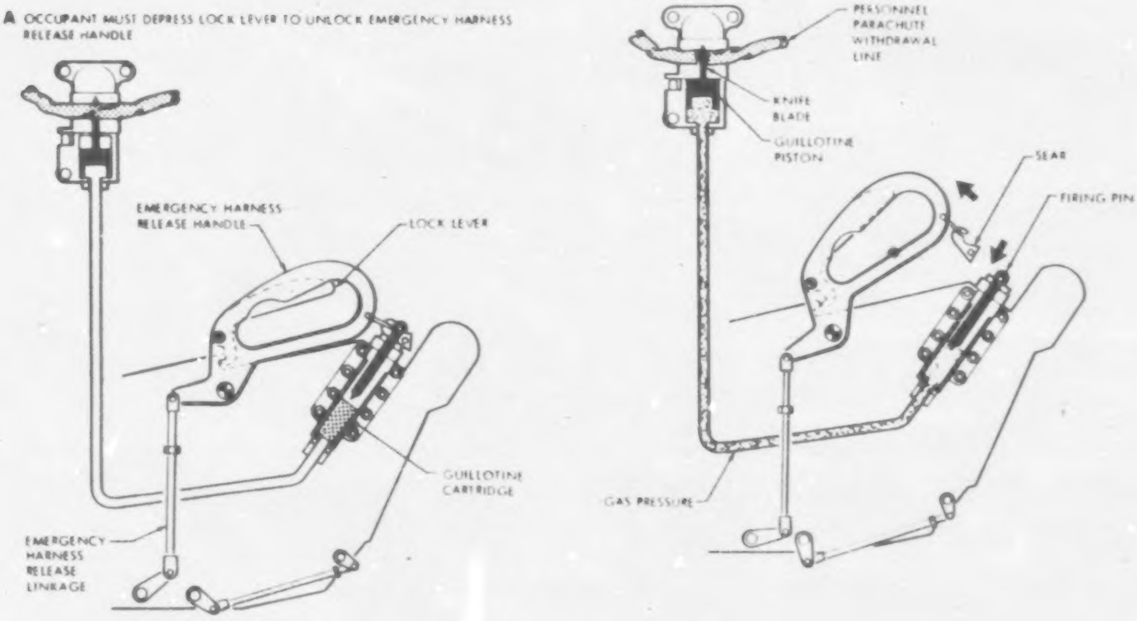
To check out the firing mechanism, it is removed from the seat and inspected for corrosion, cleanliness, and condition of threads. It is then placed in a vise. Using the same firing pin extractor tool as for the catapult gun firing mechanism, lift the firing pin and remove the sear. There should be no abnormal binding in movement of the firing pin when removing the sear.

With the sear removed from the mechanism, attach a spring scale (0-25 pound) to the firing pin extractor tool and connect the tool to the firing pin. Pull upward on the spring scale and observe the reading on the scale when the firing pin starts to move upward. The pull required should not be less than 8 pounds.

With the firing pin protruding from the lower end of the mechanism, measure the pin protrusion with a depth micrometer. The pin should protrude an amount specified in the applicable Maintenance Instructions Manual.

To check out the guillotine knife assembly, disconnect the personnel parachute withdrawal line (link line) and remove the line from the assembly. Cut the lockwire and remove the flexible hose from the bottom of the assembly. Remove the guillotine from the seat, taking care not to force the piston cutter blade assembly up with the guillotine assembled. Forcing the piston cutter blade assembly up and over the detent plunger may produce burrs on the plunger that can result in a guillotine "locked shut" firing. Remove the guillotine from the seat, disassemble it, and inspect all parts for corrosion, cracks, and distortion, and the hose for service life. Inspect the piston cutter plunger for freedom from burrs.

The guillotine is assembled in reverse order of disassembly. Replace the hose and lockwire it securely. Route the parachute withdrawal line through the assembly and connect the line at the quick-release coupling.


EMERGENCY HARNESS RELEASE HANDLE
LOCK LEVER
GUILLOTINE CARTRIDGE
EMERGENCY HARNESS RELEASE LINKAGE
PERSONNEL PARACHUTE WITHDRAWAL LINE
KNIFE BLADE
GUILLOTINE PISTON
SEAR
FIRING PIN
GAS PRESSURE

A OCCUPANT MUST DEPRESS LOCK LEVER TO UNLOCK EMERGENCY HARNESS RELEASE HANDLE

B PULLING EMERGENCY HARNESS RELEASE HANDLE AFT, EXTRACTS SEAR FROM FIRING PIN IN THE FIRING MECHANISM

C FIRING PIN STRIKES PERCUSSION CAP ON THE CARTRIDGE. GAS PRESSURE GENERATED BY CARTRIDGE TRAVELS TO GUILLOTINE PISTON THRU CONNECTING TUBING.

D THE GAS PRESSURE FORCES THE GUILLOTINE PISTON, TO WHICH A KNIFE BLADE IS ATTACHED, UP TO SEVER THE PERSONNEL PARACHUTE WITHDRAWAL LINE.

E OCCUPANT IS NOW ABLE TO PUSH FREE OF THE SEAT AND PULL THE "D" RING WHICH DEPLOYS THE PERSONNEL PARACHUTE FOR A NORMAL DESCENT TO THE GROUND

NOTE

IN ADDITION TO FIRING THE GUILLOTINE, THE EMERGENCY HARNESS RELEASE HANDLE RELEASES THE LAP BELTS, HARNESS LOOP STRAPS, LEG RESTRAINT CORDS AND PERSONAL PARACHUTE RESTRAINT STRAPS.

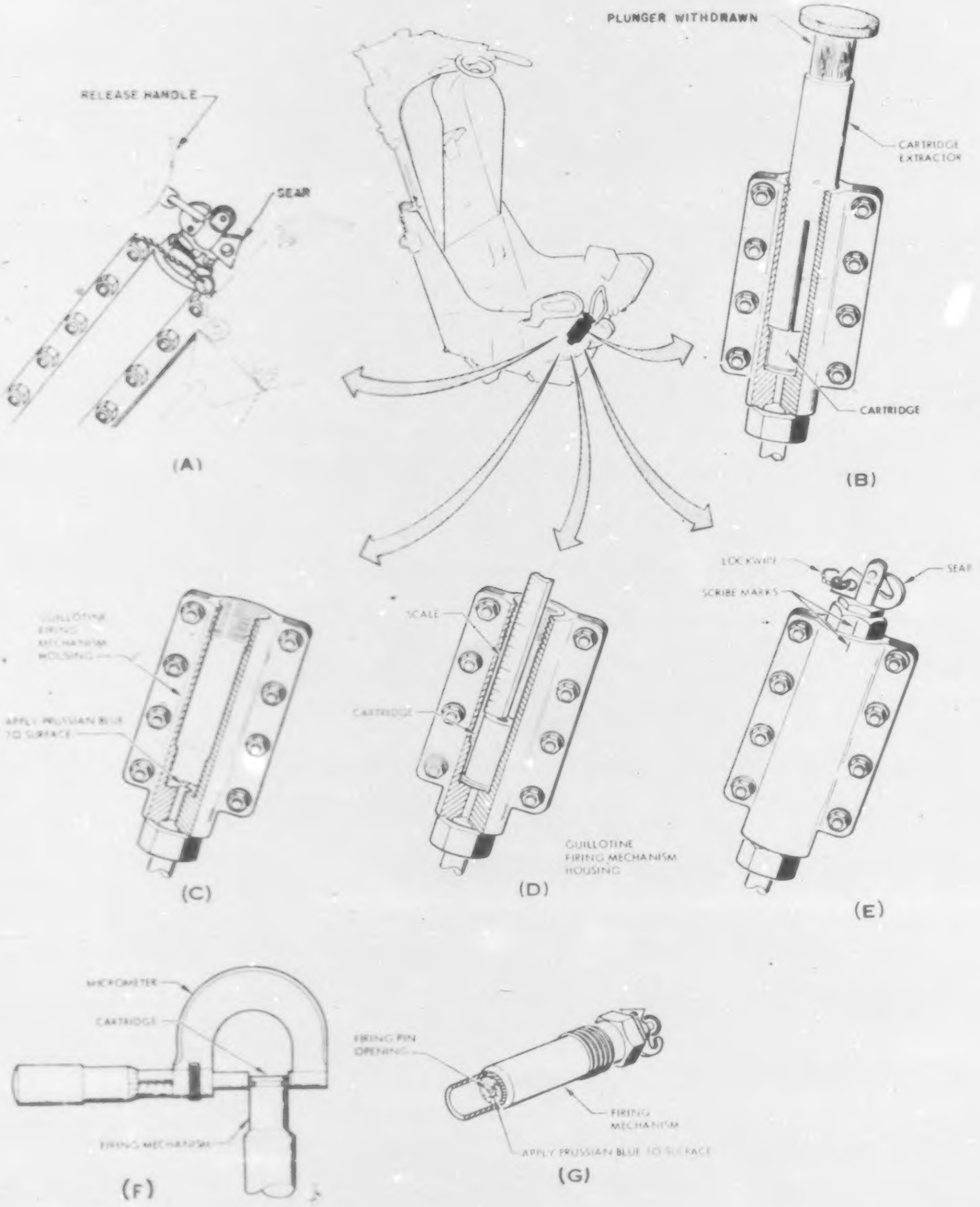
AM.681

Figure 8-29.—Guillotine assembly operation.

Attach a spring scale (0-10 pound) to the top of the guillotine trap door. Pull the door with the scale and observe the reading on the scale when the door just begins to open. The required pulling force should be the amount specified in the applicable Maintenance Instructions Manual.

Prior to installation, insure that the original cartridge location is maintained by checking the cartridge block data card. The AME then installs the empty firing mechanism handtight until it bottoms in the firing mechanism housing. If installation is not smooth, hand-lap the firing mechanism in the firing mechanism housing until smooth operation is obtained. After the lapping operation is completed, all traces of lapping compound must be removed, parts cleaned, and a light coat of oil applied.

Prior to installing the cartridge in the firing mechanism, insure that the sear is lockwired and the firing pin is not protruding from the base of the firing mechanism. Insert the guillotine cartridge into the firing mechanism and place a


PLUNGER WITHDRAWN
RELEASE HANDLE
CARTRIDGE EXTRACTOR
SEAR
CARTRIDGE
(A)
(B)
LOCKWIRE
SEAR
SCRIBE MARKS
GUILLOTINE FIRING MECHANISM HOUSING
SCALE
APPLY PRUSSIAN BLUE TO SURFACE
CARTRIDGE
GUILLOTINE FIRING MECHANISM HOUSING
(C)
(D)
(E)
MICROMETER
CARTRIDGE
FIRING PIN OPENING
FIRING MECHANISM
FIRING MECHANISM
APPLY PRUSSIAN BLUE TO SURFACE
(F)
(G)

AM.652

Figure 8-30.–Guillotine firing mechanism and cartridge removal and installation.

micrometer over the end of the firing mechanism as shown in view (F) and check the runout of the cartridge flange by rotating the cartridge. Cartridge flange must not bind on the micrometer.

Apply a thin coating of prussian blue to the base of the firing mechanism, view (G), and then insert the cartridge and check into the firing mechanism body. Rotate the cartridge by hand and then remove the cartridge for transfer of the prussian blue to the top of the cartridge. If transfer does not occur, the firing mechanism must be reamed to specified dimensions or replaced with a serviceable part.

Apply a thin coat of prussian blue to the bottom of the firing mechanism body as shown in view (C). Then install the cartridge extractor as follows:

1. Place the cartridge in the extractor and insert the assembly into the firing mechanism housing.

2. Depress the cartridge extractor plunger to release the cartridge, then remove the extractor.

The distance between the top of the cartridge and the top of the firing mechanism housing is measured as illustrated in view (D) and recorded. Remove the cartridge and check for the transfer of prussian blue to the base of the cartridge. If transfer does not occur, the cartridge has not bottomed in the housing and the cause of this failure must be corrected.

Clean the prussian blue from the cartridge and housing, install the cartridge in the housing, and remeasure the distance from the top of the cartridge to the top of the cartridge housing. The distance should be the same as recorded previously. Repeat the application of prussian blue to the base of the firing mechanism and install the firing mechanism in the cartridge housing. After applying a specified torque to the firing mechanism, place a scribed mark on the hex nut of the firing mechanism and a corresponding mark on the cartridge housing. The firing mechanism is again removed from the housing–counting the number of turns required for its removal. Check for the transfer of prussian blue to the top of the cartridge. If transfer does not occur, the firing mechanism has not bottomed on the cartridge and the cause of the failure must be corrected.

When the installation procedure has progressed to this point satisfactorily, the prussian blue is cleaned from the cartridge and mechanism. Furthermore, the cartridge and mechanism final installation is performed–counting the number of turns required to tighten the mechanism to the correct torque.

Check the alignment of the scribe marks and insure that the number of full turns required to install the mechanism is the same as noted during previous removals. When the firing mechanism is installed correctly, lockwire the firing mechanism to the housing. Remove the nut and bolt wire from the sear safety pin hole and install the guillotine safety pin. With the safety pin installed, push aft on the sear and connect the sear to the emergency harness release handle.

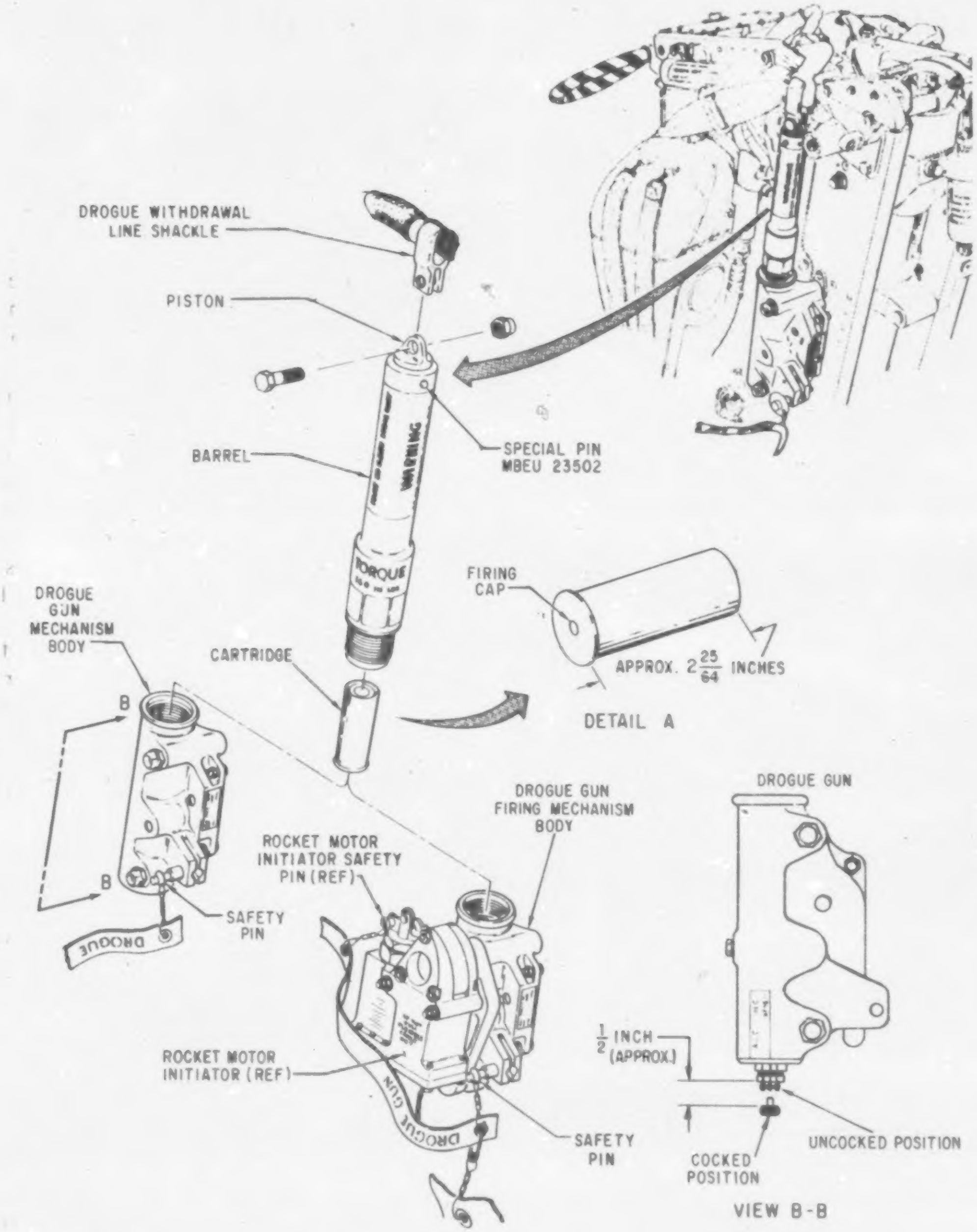
DROGUE GUN ASSEMBLY.–The drogue gun is mounted on the top left side of the main beam assembly and is used to deploy the drogue parachutes during the ejection sequence. The gun is pyrotechnically operated and its main components consist of the firing body, barrel, and piston. (See fig. 8-31.)

During ejection, a trip rod attached to the catapult gun anchor bracket pulls a sear from the firing body actuating the drogue gun timing mechanism. After the proper time delay has occurred, the spring-loaded firing pin is released, firing the drogue gun cartridge. Gas pressure generated by the cartridge propels the piston out of the barrel. The piston, which is attached to the drogue withdrawal line, pulls the drogue parachute from the drogue container. For further descriptive information, review Aviation Structural Mechanic E3 & 2, NavTra 10309-C.

Drogue Gun Cartridge Removal and Installation.–Insure that the ground safety pin is installed in the drogue gun safety pin hole. The sear must be installed in the drogue gun and must not be removed until the barrel and cartridge have been separated from the drogue gun firing body.

Disconnect the drogue withdrawal line shackle from the drogue gun piston. Remove lockwire from the drogue gun firing body and the barrel.

Loosen and remove the barrel and the cartridge from the firing body, taking care that the cartridge does not fall from the barrel. It is


DROGUE WITHDRAWAL LINE SHACKLE
PISTON
BARREL
SPECIAL PIN MBEU 23502
WARNING
TORQUE
FIRING CAP
APPROX. 2 25/64 INCHES
DETAIL A
DROGUE GUN MECHANISM BODY
CARTRIDGE
B
B
SAFETY PIN
DROGUE
ROCKET MOTOR INITIATOR SAFETY PIN (REF)
DROGUE GUN FIRING MECHANISM BODY
ROCKET MOTOR INITIATOR (REF)
DROGUE GUN
SAFETY PIN
DROGUE GUN
1/2 INCH (APPROX.)
COCKED POSITION
UNCOCKED POSITION
VIEW B-B

AM.693

Figure 8-31.–Drogue gun cartridge removal and installation.

recommended that a special cartridge extractor tool for removing the drogue gun cartridge be used. Figure 8-32 illustrates the cartridge being removed with the aid of this tool. If the cartridge still refuses to come out of the barrel, replace both the barrel and the cartridge.

CAUTION: The drogue gun cartridge is also a percussion fired item and may explode on impact. Handle it carefully.

Carefully remove the cartridge from the drogue gun barrel and place it in a cartridge block. Record the seat position and the aircraft serial number on the cartridge block data card and deliver the cartridge to the work center for proper storage. Reinstall the barrel into the firing body fingertight to prevent contamination.

With the drogue gun removed, it is cocked by inserting its sear into the slot of the locking plunger with the cam side outboard as illustrated in figure 8-33 (A). Lock the sear in place by pushing in on the locking plunger – the drogue gun ground safety pin may be used for this purpose (view B). The hex head cocking indicator and washer are then removed from the bottom of the firing body and the threaded portion of the cocking tool is screwed in place (view C). Hold the firing body securely and pull the cocking tool to its full limits. When tension is released on the cocking tool, return motion should be approximately one-eighth inch as the mechanism locks in the cocked position.

While cocking, no binding or restriction should be felt other than spring tension. The locking mechanism's operation will be audible during the cocking operation.

After cocking, insert the drogue gun ground safety pin in the safety pin hole and insure that the firing pin is not protruding above the bottom surface of the cartridge chamber. Next, remove the cocking tool and install the hex head cocking indicator and washer in the bottom of the drogue gun firing body. If the gun is cocked properly, the knurl stop on the end of the cocking indicator will extend from the hex head nut as shown in figure 8-33.

After cocking, attach the start and stop switch assemblies to the drogue gun and connect the plugs from these assemblies to their receptacles in the relay control section of the time clock as illustrated in figure 8-34. Then connect the time clock to the required electrical power source and turn the unit on, insuring that both hands are zeroed. If not, zero both hands, using the trip lever just above the clock face.

To perform the time delay check, pull the sear sharply from the drogue gun, causing the timer to start. When drogue gun escapement fires, it will stop. To insure that the correct time delay is used, the AME must follow the procedure given in the applicable Maintenance Instructions Manual. When the test is complete, remove the power equipment from the drogue gun, then remove the gun from the holding tool.

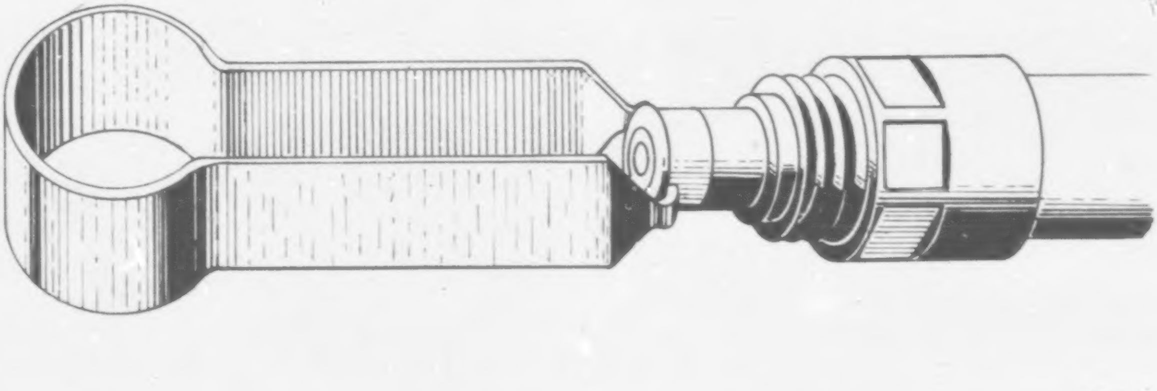
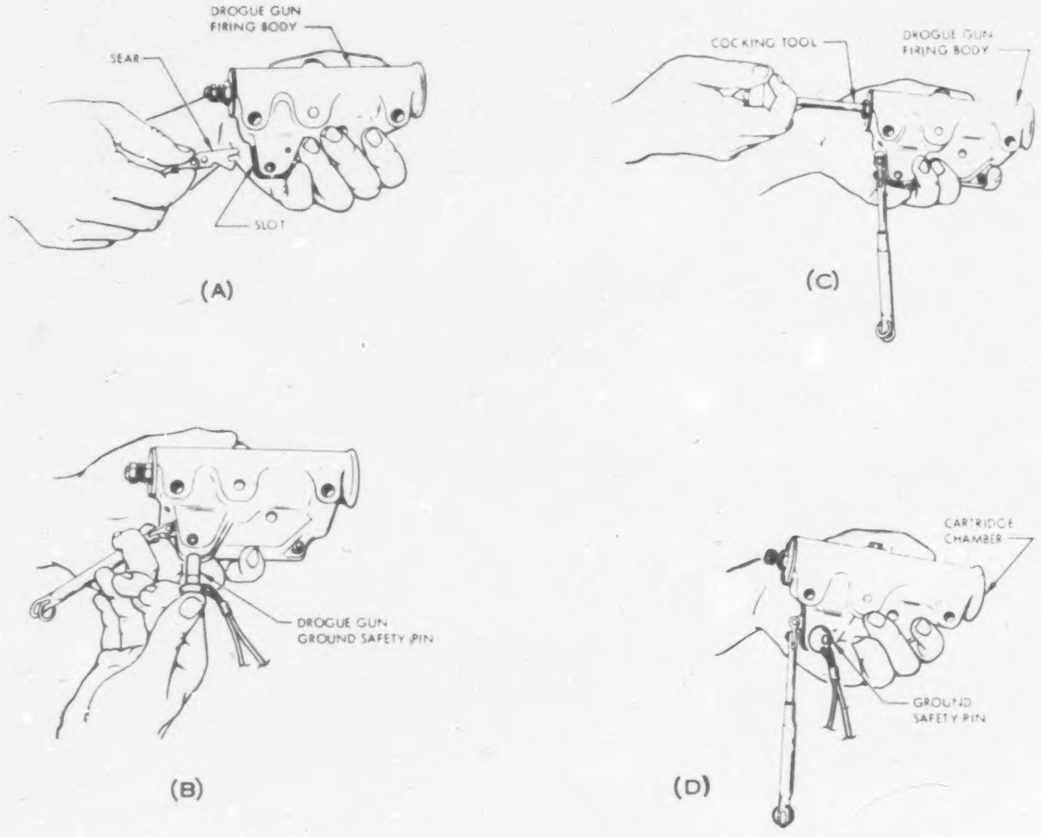


Figure 8-32.–Drogue gun cartridge removal tool.


DROGUE GUN FIRING BODY
SEAR
SLOT
(A)
COCKING TOOL
DROGUE GUN FIRING BODY
(C)
DROGUE GUN GROUND SAFETY PIN
(B)
CARTRIDGE CHAMBER
GROUND SAFETY PIN
(D)

AM.655

Figure 8-33.–Drogue gun cocking.

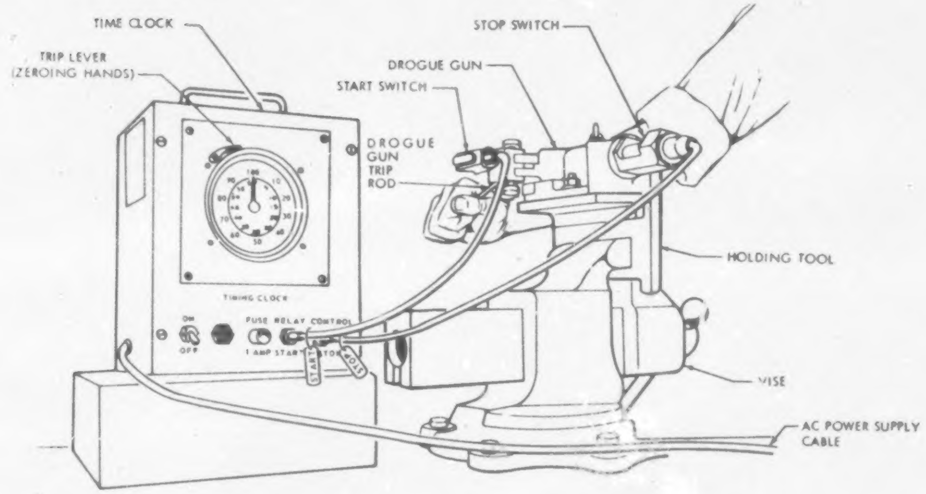
After the time delay check has been performed and prior to cartridge installation, remove the cartridge from the cartridge block and check its expiration date. In addition, check the aircraft serial number and seat location recorded on the cartridge block data card to insure that original cartridge location is maintained.

When it has been determined the cartridge is ready for installation, remove the barrel from the drogue gun and check to see that the special pin is properly installed in the barrel and piston. Substitutes for these special pins may not be used. In order to aid in their identification, some pins have an "O" stamped on the rivet-like head or painted yellow.

Ascertain that the drogue gun is cocked and that the sear and the ground safety pin are installed in the drogue gun firing body. If a new drogue gun firing body or barrel is being installed, pretorquing of the drogue gun barrel with a dummy cartridge must be accomplished as follows:

1. Install the dummy cartridge in the barrel and screw the barrel into the firing body.

2. Torque the barrel into the firing body to the required torque, then loosen the barrel.



AM.656

Figure 8-34.—Drogue gun time delay check.

3. Repeat step (2) five times. Remove the barrel from the firing body and remove the dummy cartridge from the barrel.

NOTE: Prior to inserting a live cartridge in the barrel, insure that the firing pin is not protruding from the bottom surface of the firing chamber. If the barrel and cartridge assembly is screwed into a chamber into which the firing pin is protruding, the cartridge may fire.

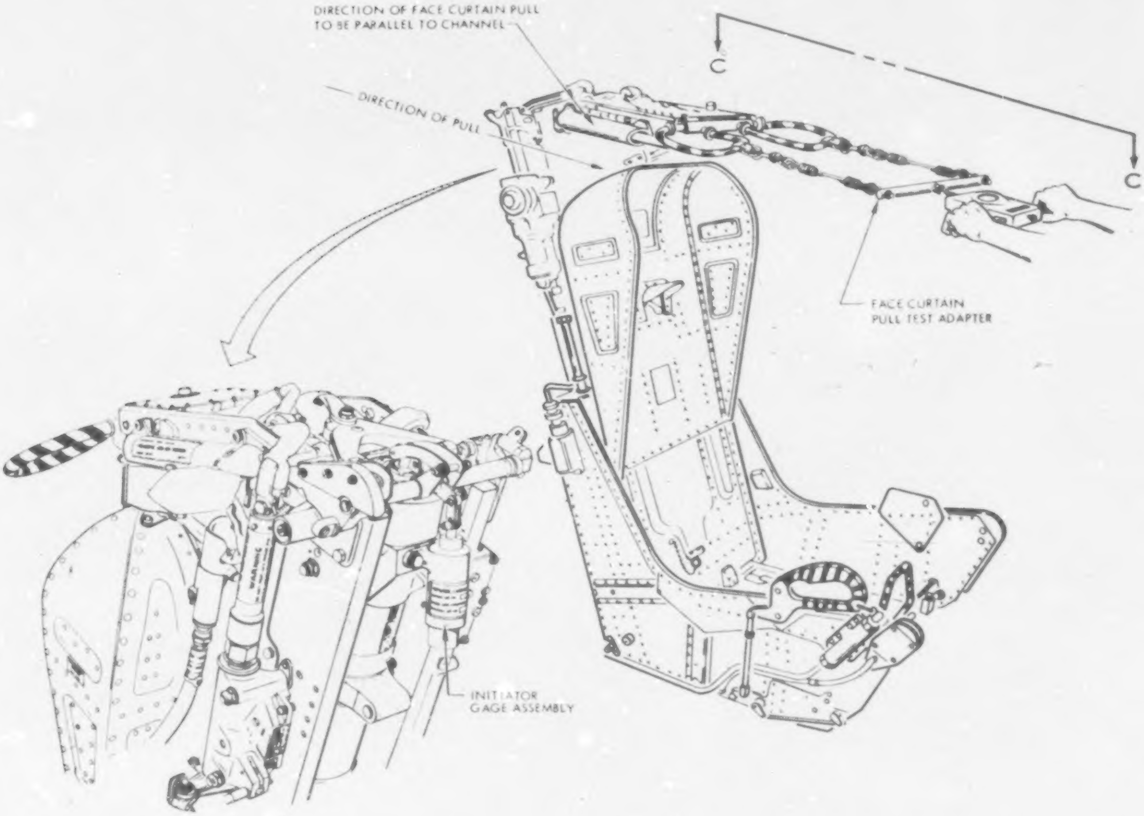
Insert the cartridge into the gun barrel and carefully screw the barrel into the firing body. Tighten the assembly to the required torque as stated in the applicable Maintenance Instructions Manuals. Then lockwire the barrel securely to the firing body and fix a lead seal to the lockwire. The drogue parachute withdrawal line shackle is then connected to the drogue gun piston to complete the installation.

FACE CURTAIN AND SECONDARY INJECTION HANDLE.–Make certain that all ground safety pins are correctly installed on the seat. Remove the catapult gun primary cartridge, then reinstall the firing mechanism in the gun and connect the banana links to the sear.

Remove the initiator from the seat and install the test gage assembly in its place. The gage simulates the initiator in checking this portion of the operation of the emergency ejection system on the seat and in the aircraft. Connect the initiator firing links to the gage and install a spare canopy interlock block in the interlock mechanism.

Attach a 0-100 pound spring scale to the face curtain handle. Pull the scale, at an angle as shown in figure 8-35, until the face curtain breaks away from the seat, observing the scale reading at the time of breakaway. The force required to pull the handle from the seat should be 60 (±10) pounds.

Continue pulling the face curtain until the plunger of the gage separates from the gage body and the sear separates from the firing mechanism. The gage plunger should separate from the firing mechanism if the face curtain linkage is operating properly. If the foregoing test conditions cannot be met, the mechanism should be checked for alignment and retested. When the check is satisfactory, repack the face curtain in the seat.


DIRECTION OF FACE CURTAIN PULL TO BE PARALLEL TO CHANNEL
DIRECTION OF PULL
C
C
FACE CURTAIN PULL TEST ADAPTER
INITIATOR GAGE ASSEMBLY

AM.657

Figure 8-35.—Face curtain pull test.

Next, cock the gage assembly, reinstall the sear in the firing mechanism, connect the banana links to the sear, and attach the spring scale to the alternate ejector handle. Rotate the handle guard downward and pull the ejector handle upward with the spring scale. The force required to pull the handle from its receptacle can be found in the appropriate MIM.

Continue pulling the handle upward until the gage plunger again separates from the body and the sear separates from the firing mechanism. Should either separation fail to occur, the mechanism should be checked for alignment and retested. The secondary ejection handle test is conducted with the seat bucket in the up, middle, and full down position on the H-7 ejection seat.

STICKER CLIP TENSION CHECK.—Install sticker strap lugs of the harness in the sticker clips on both sides of the seat bucket.

Check tension of each sticker clip by attaching a 0-100-pound spring scale to the lug and applying tension until the lug breaks free of the clip. The specific breakaway force for the H-7 sticker clip can be found in the appropriate MIM.

EMERGENCY HARNESS RELEASE MECHANISM FUNCTIONAL CHECK. For this check all ground safety pins should be properly installed on the seat, and the emergency harness release handle should be in the down and locked position. Insure that the time release mechanism is cocked and that the shoulder harness loop straps, leg restraint cords, and lap belt are properly connected to the seat.

Next, place the time release mechanism cocking tool on the time release mechanism and insert the cocking pin in the hole on the shackle release plunger (inboard plunger).

With light pressure applied to the handle on the cocking tool (fig. 8-36), pull the sear from the mechanism. This will allow the rack plunger to extend. When the rack plunger has extended completely, relieve pressure on the cocking tool to allow the shackle release plunger to fully extend. Check for release of the leg restraint cords, lap belt, loop straps, and drogue shackle from the seat.

Cock time release mechanism, and with hand tension applied to leg restraint cords, lap belt, and loop straps, push down on harness release lever (lever located on right side of seat under time release mechanism) until the leg restraint cords, lap belt, and loop straps release from the seat simultaneously.

When this part of the check is complete, reconnect the leg restraint cords, loop straps, and lap belt to their respective quick-release fittings on the seat.

NOTE: On various seats, simultaneous release of all straps and cords might not occur. In such cases, insure that the leg restraint cords release before the lap belt, and that the loop straps release after the lap belt. For the proper sequence, the applicable Maintenance Instructions Manual must be consulted.

To insure positive results, these procedures should be repeated at least twice.

Connect loop straps, leg restraint cords, and lap belt to their respective quick-release fittings on the seat and disconnect the guillotine firing mechanism from the emergency harness release handle.

With hand tension applied to the leg restraint cords, lap belt, and shoulder harness loop straps, depress the trigger of the emergency harness release handle and slowly pull the handle upward as far as it will go. The loop straps, leg restraint cords, and lap belt should all release from the seat and the handle should lock in the up position. During this part of the check, insure that the lap belt and leg restraint cords release from each side of the seat evenly. The leg restraint cords should release before the lap belt, while the loop straps should release simultaneously with the lap belt or slightly before.

When the check is complete, the release handle should be placed in the down and locked position, the harness, lap belt, and restraint cords reinstalled, and the guillotine sear connected to the emergency harness release handle.

LEG RESTRAINT MECHANISM CHECK. The leg restraint cords should be carefully inspected for cuts, wear, fraying, mildew, or deterioration, any of which is generally reason for replacement.

Check the action of the snubber by pulling forward on the restraint cord.

With tension still applied to the cord, check the releasing action by pulling out on the snubber finger ring until the cord releases. When released, the cord should pull out without signs of abnormal binding or drag.

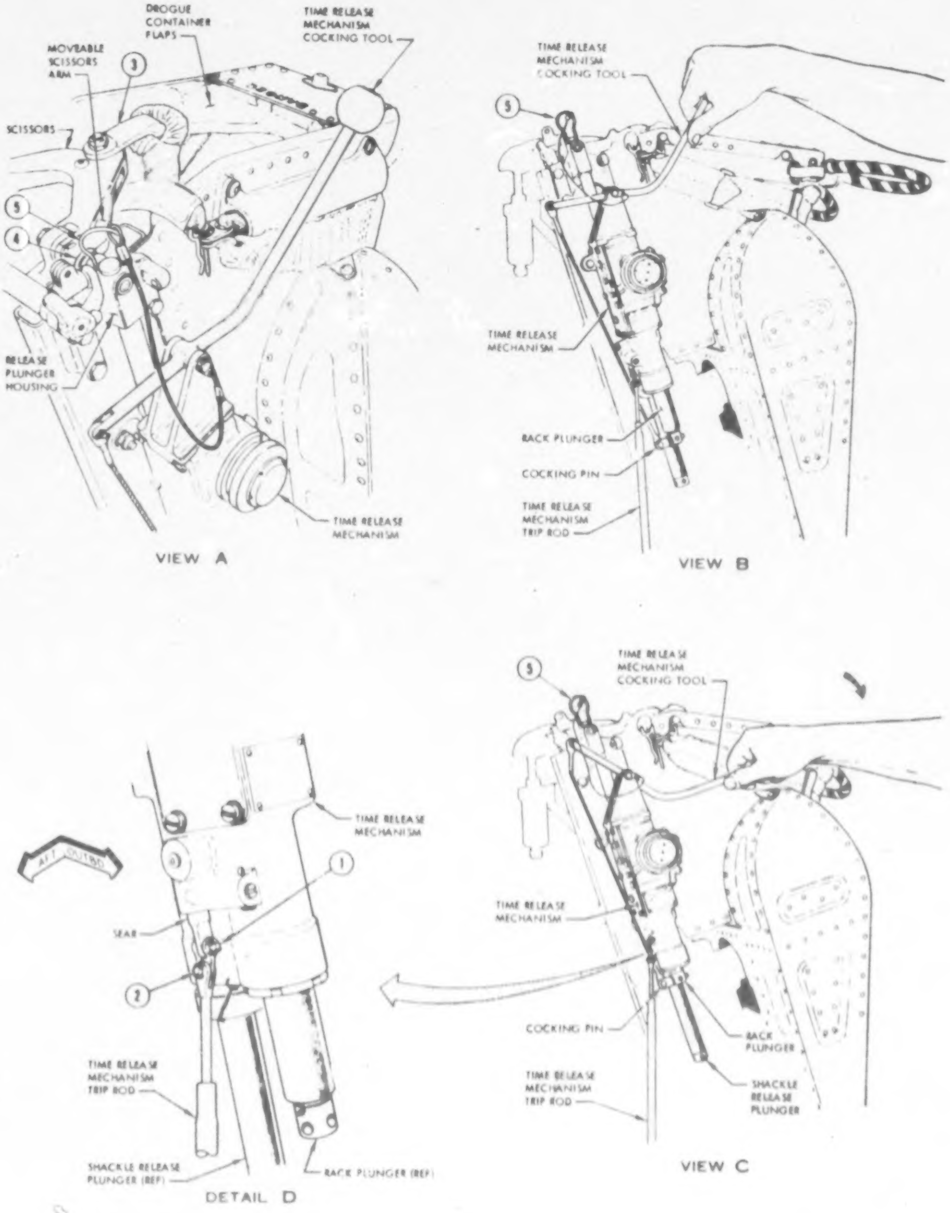
To check operation of the leg restraint manual release, insert the cord lockpins in the lockpin receptacles. Pull the manual release handle aft and check to see that the cord lockpin releases from the receptacle.

SCISSORS MECHANISM CHECK. For this check the time release mechanism must be cocked. Using a feeler gage, check the gap between the jaws of the scissors for proper clearance which can be found in the appropriate MIM.

Next, place the scissors in a vertical position and attach a 0 to 100-pound spring scale to the top of the scissors. Pull straight forward on the spring scale and observe the force reading on the scale when the scissors just begin to rotate forward.

The force required can be obtained by adding or removing special shims as necessary to the scissors securing bolts until the proper scissor force is obtained. Refer to the applicable Illustrated Parts Breakdown for the part number of the proper shim material.

TIME RELEASE MECHANISM CHECKOUT. This checkout is composed of two checks time delay check and barostat check. Frequent reference should be made to


DROGUE CONTAINER FLAPS
TIME RELEASE MECHANISM COCKING TOOL
MOVEABLE SCISSORS ARM
3
SCISSORS
5
4
RELEASE PLUNGER HOUSING
TIME RELEASE MECHANISM
VIEW A
TIME RELEASE MECHANISM COCKING TOOL
5
TIME RELEASE MECHANISM
RACK PLUNGER
COCKING PIN
TIME RELEASE MECHANISM TRIP ROD
VIEW B
5
TIME RELEASE MECHANISM COCKING TOOL
TIME RELEASE MECHANISM
AFT OUTBD
1
SEAR
2
TIME RELEASE MECHANISM TRIP ROD
SHACKLE RELEASE PLUNGER (REF)
RACK PLUNGER (REF)
DETAIL D
TIME RELEASE MECHANISM
COCKING PIN
RACK PLUNGER
TIME RELEASE MECHANISM TRIP ROD
SHACKLE RELEASE PLUNGER
VIEW C

AM.181

Figure 8-36.--Time release mechanism cocking.

figure 8-37 during the discussion of these checks.

For the time delay check remove the time release mechanism (1) from the seat, and install the switch actuator collars (2) and (3) on the shackle release plunger and rack plunger, respectively. Mount the time release mechanism on the test switch assembly (4) so that the three locating pins are engaged in the three mounting holes of the mechanism and the tong on the switch actuator collar (3) is engaged in track of test switch assembly. Adjust stop (5) to bear against the mounting pad and tighten the three clamps (6).

Connect the trip rod assembly to sear, using chain attached pin (7). Install trip lever (24) on trip lever arm (8) and pull lever to fully seat sear on time release mechanism. Push trip lever forward gently to remove slack in trip rod assembly and remove lever. Observe that the sear did not move from seated position.

NOTE: The trip lever is used on the trip lever arm and on the cocking mechanism.

Install trip lever on the cocking mechanism and cock the rack and shackle release plungers. Loosen the switch mounting bracket bolts (9) and position each bracket so that the roller on the switch actuator is on the slope of the switch actuator collar.

Connect the test leads from the multimeter to pins C and D of the connector (10) and adjust the switch actuator bolt (11) on the trip rod assembly until switch (12) is just open. Continue adjustment of the bolt one-quarter turn. Place the power switch (13) in the ON position, connect the multimeter to pins A and B of connector and adjust switch actuator bolt (14) until switch (15) is just open. Continue adjustment of bolt one quarter turn and turn the power switch to the OFF position.

Connect the multimeter to pins E and F of the connector and adjust switch actuator bolt (16) until switch (17) is just open. Continue adjustment of the bolt one-quarter turn and then connect the test switch assembly to the timer (18) and connect the timer to the electrical power source (115 volts, 60-hz a.c.). Place the timer switch ON and zero the timer pointers.

Install the trip lever on the trip lever arm and apply a rapid pushing force to the lever to disengage the sear. Check reading of the timer when the release mechanism has completed actuation. The timer must show an elapsed time in accordance with that specified in the appropriate MIM.

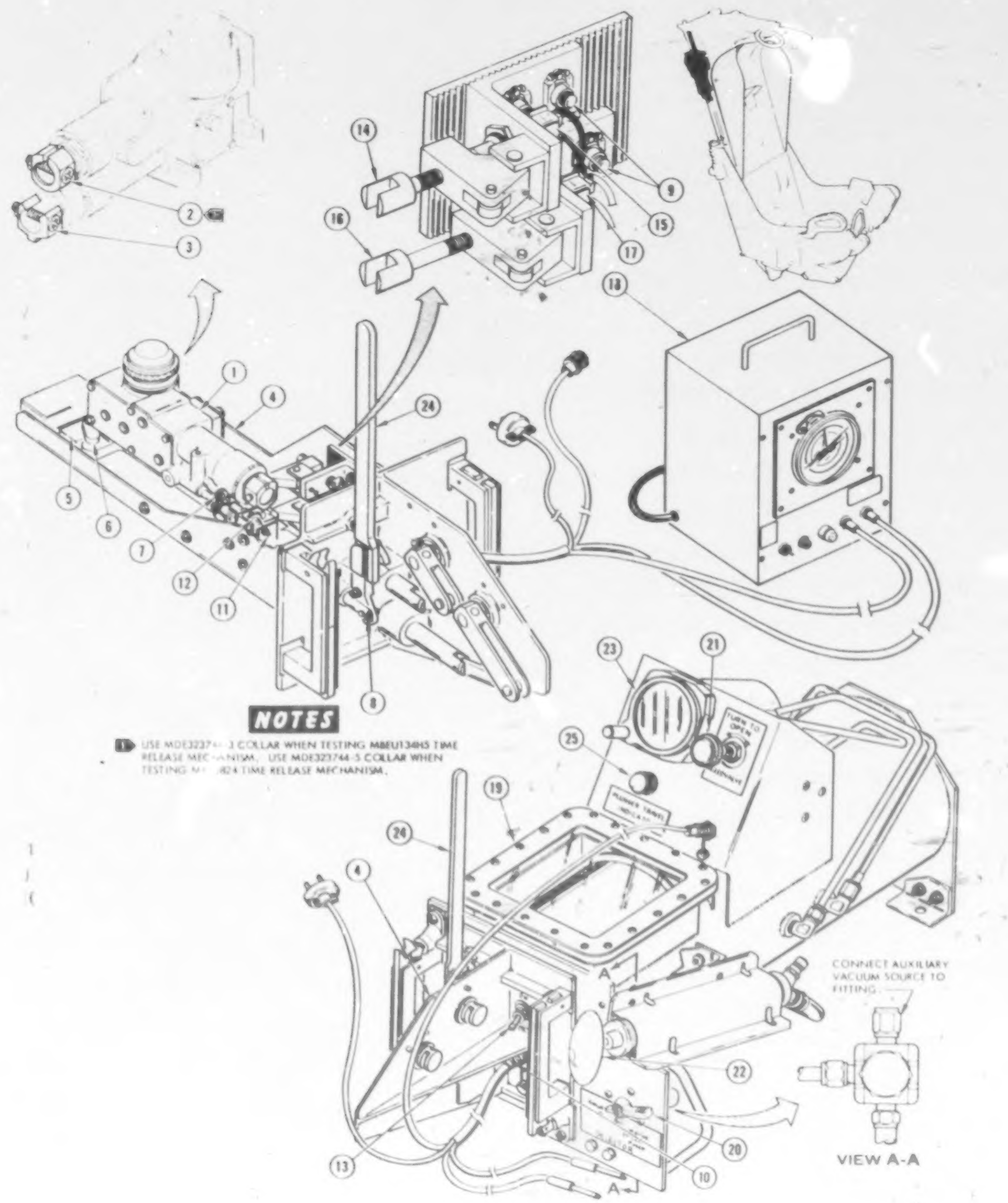
Repeat the above test procedure at least three times in order to insure positive test results.

In performing the barostat check, repeat all of the above procedures down through connecting the multimeter to pins E and F of the connector and adjusting bolt (16) until switch (17) is just open, and then place the mechanism in barostat checkout chamber (19).

Connect the cable from the test switch assembly to the vacuum chamber, plug into the electrical power source, and place power switch (13) in the ON position. Turn the handle of valve (20) to the manual pump position, close bleed valve (21), and set the altimeter pressure scale to 29.92. Increase the chamber altitude to 20,000 feet with hand pump (22). Observe altitude on altimeter (23).

NOMENCLATURE FOR FIGURE 8-37.

1. Time release mechanism.
2. Switch actuator collar.
3. Switch actuator collar.
4. Test switch assembly.
5. Stop.
6. Clamp (3 each).
7. Pin.
8. Trip lever arm.
9. Bolt (4 each).
10. Connector.
11. Switch actuator bolt.
12. Switch (start).
13. Power ON/OFF switch.
14. Switch actuator bolt.
15. Switch (light).
16. Switch actuator bolt.
17. Switch (stop).
18. Timer 134GT1041-T5 (component of test unit).
19. Barostat checkout vacuum chamber.
20. Selector valve.
21. Bleed valve.
22. Hand pump (vacuum).
23. Altimeter.
24. Trip lever.
25. Plunger travel indicator lamp.


14
16
9
15
17
18
2
3
1
4
24
5
6
7
12
11
8
23
21
25
19
24
4
A
22
20
10
13
A
CONNECT AUXILIARY VACUUM SOURCE TO FITTING.
VIEW A-A

NOTES

1 USE MDE3237[illegible]-3 COLLAR WHEN TESTING M8EU134H5 TIME RELEASE MECHANISM. USE MDE323744-5 COLLAR WHEN TESTING M[illegible]824 TIME RELEASE MECHANISM.

AM.659

Figure 8-37.–Timer release mechanism checkout.

NOTE: If chamber evacuation with hand pump (22) is slow, lubricate the pump plunger with grease and insure that the test assembly is sealed by using the latches provided in the handles. If available, an auxiliary vacuum source may be used in place of the hand pump. Connect vacuum source to vacuum fitting as shown in view A-A and turn the handle of valve (20) to the motor operation pump position.

Pull the sear from the release mechanism with trip lever (24); the mechanism must not operate. Slowly bleed air into the chamber with valve (21) and observe the altimeter. The release mechanism must start to actuate at a specified height for the type seat being checked.

NOTE: Actuation of the release mechanism is signaled by illumination of indicator light (25) and stoppage of chamber descent by the solenoid valve. Chamber altitude may be reduced to zero with the bleed valve after the power switch is turned to the OFF position.

Repeat the above test procedure at least three times to insure positive test results.

TOP LATCH MECHANISM. The top latch mechanism is located on the left side of the main beam assembly, and its purpose is to lock the ejection seat to the aircraft. This locking action is accomplished by a plunger that protrudes through a hole in the catapult gun outer barrel into the chamferred groove of the inner barrel primary cartridge breech.

During an ejection sequence, the top latch mechanism is released by the upward travel of the inner barrel of the catapult gun. (See fig. 8-38 (A).)

In maintenance of the catapult gun and seats, the top latch mechanism is unlocked by installing a handwheel on the top latch plunger and turning it fully clockwise.

When the handwheel is removed from the top latch plunger, an unlocking indication is given by the position of the plunger and indicator within the mechanism housing. Proper locking is indicated when the locking indicator, plunger, and mechanism housing are all flush with each other. Figure 8-38 (B) shows the top latch mechanism in the locked, unlocked, and wrong positions.

LAP BELTS. The AME is responsible for routine inspection of lap belts, and the PR's are responsible for performing proof load tests. Lap belts are inspected daily for obvious signs of wear or deterioration of the metal parts, webbing for wear or fraying and the release buckles to see that they are functioning properly.

During calendar inspections, make a complete and thorough inspection of all equipment, as for the daily inspections, and include a close examination for corrosion, cracks, wear, fraying, rot, and broken stitches or cuts in the lap belts. Also inspect all parts of the aircraft, that the lap belts may contact, for any deformation such as sharp, jagged edges or roughness which may cause cutting or excessive abrasion.

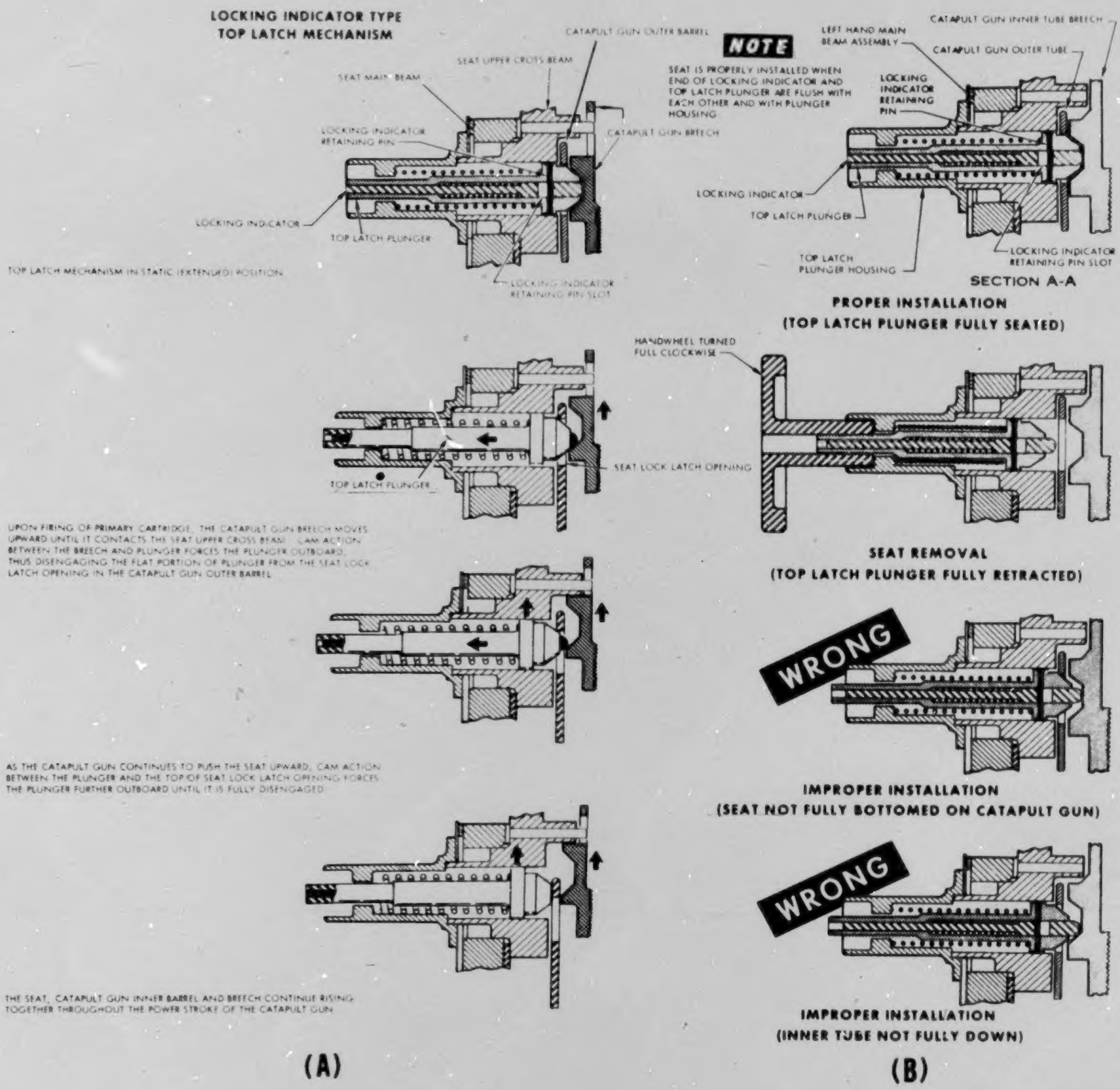
Maintenance of lap belts, loop straps and leg restraint cords is so closely related to AME's and PR's that they are required to work in harmony on these units.

SEAT BUCKET POSITIONING CHECK. To perform this check, connect electrical power to aircraft, and while sitting in the seat (at least 200 pounds of weight) actuate the seat bucket up and down.

CAUTION: Do not actuate the seat bucket for more than 30 seconds in a 10-minute period or damage to the actuator may result.

During this operation, observe guillotine gas line and electrical leads for possible interference with the harness release torque rod bracket. The guillotine gas line must flex directly outboard and must not hang or wedge between the lower end of the drogue gun and harness release torque rod bracket. The electrical leads must not stretch or hang and must have adequate clearance with the adjacent structure. The seat bucket should move freely with no binding or drag and automatically stop when the up or down limit is reached.

Next, actuate the seat bucket up and down, stopping at regular intervals throughout the travel. The seat bucket should stop and lock in this position when the switch is released.


LOCKING INDICATOR TYPE TOP LATCH MECHANISM
CATAPULT GUN OUTER BARREL
SEAT UPPER CROSS BEAM
SEAT MAIN BEAM
LOCKING INDICATOR RETAINING PIN
CATAPULT GUN BREECH
LOCKING INDICATOR
TOP LATCH PLUNGER
LOCKING INDICATOR RETAINING PIN SLOT
NOTE
CATAPULT GUN INNER TUBE BREECH
LEFT HAND MAIN BEAM ASSEMBLY
CATAPULT GUN OUTER TUBE
LOCKING INDICATOR RETAINING PIN
LOCKING INDICATOR
TOP LATCH PLUNGER
TOP LATCH PLUNGER HOUSING
LOCKING INDICATOR RETAINING PIN SLOT
SECTION A-A
PROPER INSTALLATION
(TOP LATCH PLUNGER FULLY SEATED)
HANDWHEEL TURNED FULL CLOCKWISE
SEAT LOCK LATCH OPENING
TOP LATCH PLUNGER
SEAT REMOVAL
(TOP LATCH PLUNGER FULLY RETRACTED)
WRONG
IMPROPER INSTALLATION
(SEAT NOT FULLY BOTTOMED ON CATAPULT GUN)
WRONG
IMPROPER INSTALLATION
(INNER TUBE NOT FULLY DOWN)
(A)
(B)
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NOTE: SEAT IS PROPERLY INSTALLED WHEN END OF LOCKING INDICATOR AND TOP LATCH PLUNGER ARE FLUSH WITH EACH OTHER AND WITH PLUNGER HOUSING

TOP LATCH MECHANISM IN STATIC (EXTENDED) POSITION

UPON FIRING OF PRIMARY CARTRIDGE, THE CATAPULT GUN BREECH MOVES UPWARD UNTIL IT CONTACTS THE SEAT UPPER CROSS BEAM. CAM ACTION BETWEEN THE BREECH AND PLUNGER FORCES THE PLUNGER OUTBOARD, THUS DISENGAGING THE FLAT PORTION OF PLUNGER FROM THE SEAT LOCK LATCH OPENING IN THE CATAPULT GUN OUTER BARREL

AS THE CATAPULT GUN CONTINUES TO PUSH THE SEAT UPWARD, CAM ACTION BETWEEN THE PLUNGER AND THE TOP OF SEAT LOCK LATCH OPENING FORCES THE PLUNGER FURTHER OUTBOARD UNTIL IT IS FULLY DISENGAGED

THE SEAT, CATAPULT GUN INNER BARREL AND BREECH CONTINUE RISING TOGETHER THROUGHOUT THE POWER STROKE OF THE CATAPULT GUN

Figure 8-38.—Top latch mechanism sequence and lock indications.

Now position the seat bucket to full up and full down position and measure the up and down travel. Travel in both directions should be that specified in the appropriate MIM, and there should also be clearance between all components on the under surface of the seat bucket and adjacent structure. At the completion of this check, remove electrical power from the aircraft.

EMERGENCY ESCAPE SEQUENCING SYSTEM.–The emergency escape sequencing system interconnects the seat and canopy systems to provide sequenced canopy jettison and seat ejection during emergency egress for both of the crewmembers.

Whenever ejection is initiated from the forward cockpit, dual sequenced ejection will always occur. When ejection is initiated from aft cockpit, it can be either dual or single depending on the position of the eject command selector valve.

The eject command selector valve (fig. 8-39), located in the aft cockpit on the left side and is installed in the normal (closed) position for single (aft seat) ejection. To select dual ejection, the valve handle must be pulled out approximately 1 inch and turned clockwise 90° (open position).

The emergency escape sequencing system, initiated by pulling the face curtain or secondary control handle, is initiated by gas pressure from one of the two seat mounted initiators. This gas pressure is routed through lines and hoses to the various seat and canopy components employed during ejection.

The portion of the system that transfers gas pressure from the forward cockpit to the aft cockpit is dual, two lines and initiators, to insure that the aft seat and canopy will eject and jettison if one of the lines is damaged or the initiator fails. Figure 8-40 shows the emergency escape sequencing system.

During dual ejection, initiated from either the forward or the aft cockpit, the aft seat is sequenced to eject first through the use of time delay initiators and actuators.

Maintenance of the emergency escape sequencing system is limited to system checkout and component removal and installation. Refer to the applicable Periodic Maintenance Requirements Manual for items to be checked and the frequencies at which the checks are to be conducted. All checks must be performed in accordance with the applicable Maintenance Instructions Manual in sequence, correcting discrepancies before proceeding with the next step. If the checkout does not meet with the results specified, reference should be made to the trouble analysis chart.

NOTE: If initiators are accidentally discharged, all sequencing system components exposed to the gases generated by the initiators must be replaced, as well as the actuated initiator.

ROCKET MOTOR. The rocket motor is a thrust producing pressure vessel which provides additional thrust to the seat during ejection. The rocket motor is located on the bottom of the seat bucket and consists of a number of small diameter combustion tubes, which contain solid propellant, and are screwed into a manifold containing nozzles. Figure 8-21 shows the rocket motor as incorporated on the H-7 ejection seat.

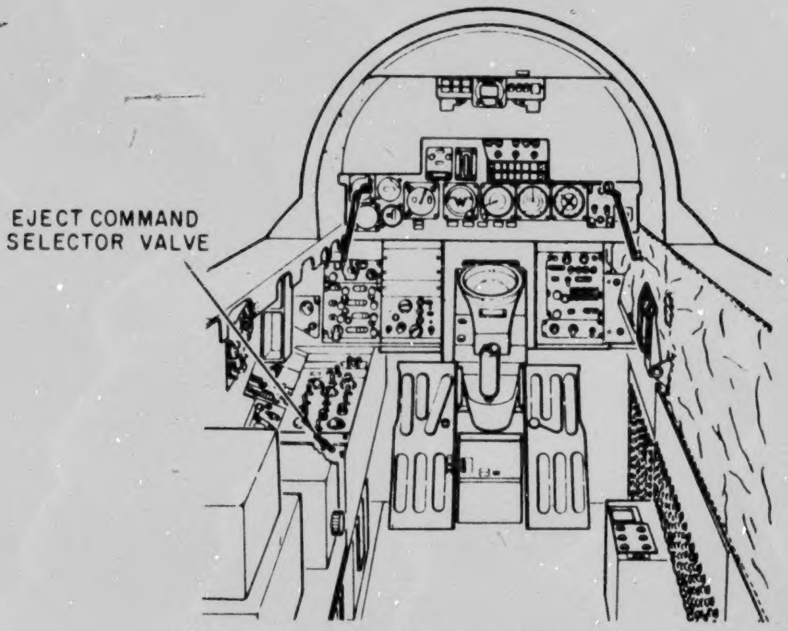
One of the combustion tubes is fitted with a firing body and igniter cartridge. When the ejection seat nears the end of the catapult gun stroke, the lanyard, attached to the drogue gun trip rod withdraws the rocket motor initiator seal. This allows the spring loaded firing pin to descend and fire the cartridge. The cartridge supplies gas pressure through the hose, to the rocket motor ignitor cartridge, causing simultaneous ignition of the rocket propellant.

A thrust angle adjustment mechanism, located on the aft left side of the rocket motor, is engaged in the incline track on the left vertical seat beam. Its purpose is to provide a pivoting action to the rocket motor, which will adjust nozzle angle to compensate for any change in the seat-occupant center of gravity due to raising or lowering of the seat bucket. Two leg guards are mounted on the combustion tubes to protect the occupant's legs from the hot tubes after rocket burnout.

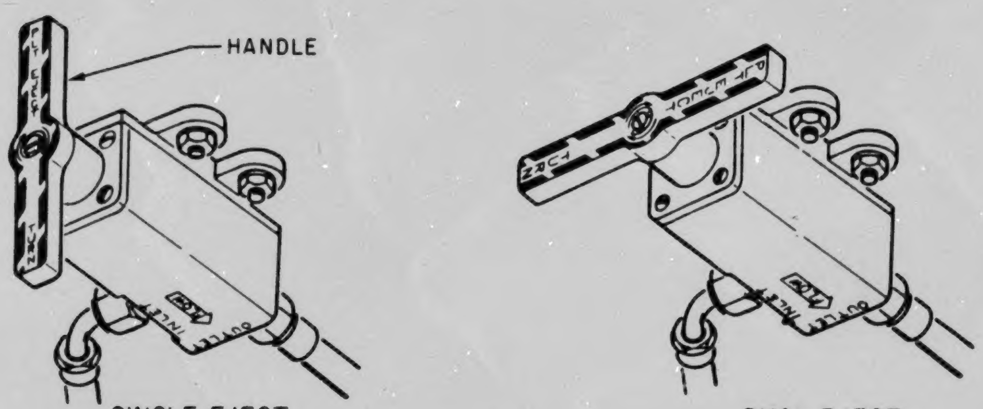
Maintenance of the rocket motor is limited to removal, installation, and inspection, as well as for checking the operation of the seat bucket position actuator to see that the thrust angle adjustment mechanism is operating properly to change the angle of the nozzles as the seat is raised or lowered.

WARNING: Before performing any check on the rocket motor, seat bucket, or ejection seat, insure that all ground safety pins have been installed. Exercise caution when performing any function in the vicinity of the rocket motor so as not to inadvertently pull the safety pin from the sear of the rocket motor.

CAUTION: Accidental firing of the rocket motor could occur. Crewmembers, as well as maintenance personnel, should be briefed and extremely cautious so as not to stow any objects under the seat bucket and to take inventory of the area under the seat before any operation of the seat bucket.


EJECT COMMAND
SELECTOR VALVE

AFT COCKPIT



SINGLE EJECT

DUAL EJECT

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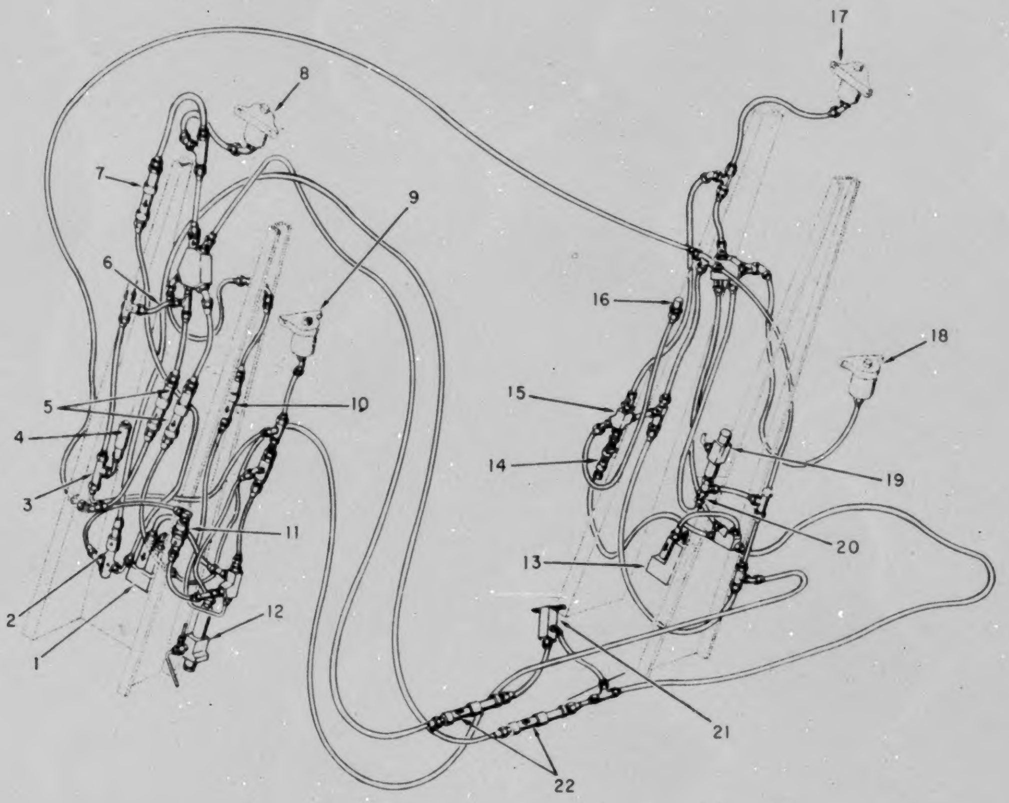
Figure 8-39.–Ejector command selector valve and location.



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1.	Pressure operated sequence actuator.	12.	FWD canopy pressure operated valve.
2.	Explosive valve.	13.	Pressure operated sequence actuator.
3.	Double check valve.	14.	Pressure operated initiator.
4.	Canopy thruster battery.	15.	Manifold.
5.	Pressure operated initiator.	16.	Inertia reel disconnect.
6.	Inertia reel disconnect.	17.	AFT seat mounted initiator.
7.	Pressure operated initiator.	18.	AFT cockpit mounted initiator.
8.	FWD seat mounted initiator.	19.	AFT canopy pressure operated valve.
9.	FWD cockpit mounted initiator.	20.	Check valve.
10.	Pressure operated time delay initiator.	21.	Ejector command valve.
11.	Pressure operated initiator.	22.	Pressure operated initiator.

Figure 8-40.—Emergency sequencing system checkout.

For further descriptive information on other components that are comprised in the Martin-Baker ejection seat, review Aviation Structural Mechanic E3 & 2, NavTra 10309-C. Information concerning rocket motors can be found by referring to the current NA11-85-1.

ESCAPAC EJECTION SEAT

The ESCAPAC ejection seat system is a fully automatic system designed to provide the pilot with a quick, safe, and positive means of escape from the aircraft under emergency conditions. The ESCAPAC rocket catapult ejection seat, used in the A-4 aircraft, provides emergency escape capabilities from ground level at a minimum of zero knots indicated airspeed, to all altitudes and airspeeds within the operational limits of the aircraft.

Description and Operation

The initial actuation of the ESCAPAC ejection seat system is accomplished by pulling the face curtain ejection control handle, located above the pilot's head, or the secondary ejection control handle, located on the front of the ejection seat bucket. Pulling either handle actuates the firing control disconnect assembly, located on the top of the seat immediately aft of the face curtain assembly and connected by cable assemblies to the face curtain handle. The ESCAPAC is then ejected from the aircraft by the Mk 13 Mod 1 or 2 rocket catapult.

The harness release bellcrank assembly, located on the lower aft portion of the seat releases all connections between the seat and occupant after ejection from the aircraft.

The ejection seat employs a positive seat separation system using a man/seat separator rocket. The thrust of the rocket simultaneously rotates and propels the seat away from the pilot, minimizing the probability of collision between the seat and the man or his parachute, after separation.

The separation system also disconnects the cables on the face curtain or secondary control handle from the ejection seat so that the pilot will separate from the seat while maintaining a grip on the handle used for ejection.

The seat stabilization system is used during the rocket burning stage of the ejection sequence. This system provides the means in which to control adverse seat rotation during seat ejection.

A back type, semirigid NES-16A parachute assembly is provided for use in conjunction with this rocket catapult ejection seat. The NES-16A parachute employs a 28-foot canopy and contains an automatic release actuator utilizing an aneroid to prevent opening above a preset altitude.

NOTE: The aneroid in the automatic release actuator does not prevent the occupant from pulling the manual D-ring and opening the parachute at a higher altitude.

Ejection Sequence

(Refer to figures 8-41 through 8-51 to aid in understanding this sequence.)

The ejection sequence of the ESCAPAC ejection seat is initiated by grasping and pulling either the face curtain or secondary ejection control handle. When either of these handles is pulled, the canopy jettison initiator and inertia reel cartridges are fired, causing the inertia reel to retract the shoulder harnesses and the canopy to jettison.

As the canopy is jettisoned, the canopy/seat interlock lanyard is withdrawn allowing additional primary ejection handle or secondary ejection handle travel. Continued pulling on either handle allows the rocket catapult initiator firing rod to move the rocket initiator crank, actuating two M-99 initiators. Gas pressure generated by the M-99 initiators ignites a Mk 12 Mod 0 cartridge-actuated initiator (0.075 second delay), and fires the rocket catapult, which starts the ejection seat on its upward travel. After a 0.075 second time delay has elapsed, gas pressure supplied by the Mk 12 Mod 0 initiator, ignites a M53 cartridge actuated initiator (booster). The booster initiator, in turn generates sufficient gas pressure to force the harness actuator piston upward within its housing. Piston movement rotates a multiple arm bellcrank assembly which retracts the lap belt and shoulder harness retaining pins.

As the ESCAPAC seat raises out of the cockpit, the anti-g and oxygen hoses are disconnected from their respective panels and the parachute time-delay actuator is armed. The pilot begins to breathe oxygen from the emergency oxygen supply bottle in the survival kit as soon as the oxygen hose is disconnected.

The force of the seat moving upward draws the pilot's legs down and back against the front panel of the seat to protect them from injury as the seat leaves the cockpit.

As the seat nears the top of the guide rails, the sustained portion of the catapult is ignited and the 2,000 pound-per-second impulse rocket catapult accelerates the seat from the aircraft to a height sufficient to permit the pilot to descend safely by the parachute.

In addition, as the seat travels upward, the seat stabilization system, connected to the seat and cockpit floor, is deployed. This keeps the seat from rotating adversely forward or aft during the ejection seat rocket burning stage.

After a 0.075-second delay, the spring tensioned firing pin fires the Mk 12 Mod 0 initiator. This firing initiates the M53 booster, the resultant gas pressure forces the piston rod into the harness release actuator housing, rotating a multiple arm bellcrank attached to the seat, and retracts the lap belt and shoulder harness retaining pins.

A clevis on the piston rod end contacts the firing control disconnect arm, pulls the firing control disconnect cable, and withdraws the spring-loaded firing control disconnect pin, freeing the actuated firing control handle. Full travel of the harness release actuator piston allows the pressurized gas to travel through the outlet port of the actuator to the man/seat separator rocket, located on the upper left-hand side of the seat, firing the separator rocket. The thrust of the rocket motor simultaneously rotates and propels the seat away from the crewman. The parachute actuator arming lanyard is pulled when man/seat separation occurs. When the parachute actuator is armed during man/seat separation between ground level up to an altitude of approximately 14,000 feet, the actuator opens the parachute after a 0.75-second delay. If ejection occurs above 14,000 feet, an aneroid contained in the actuator will delay deployment of the parachute until the pilot free-falls to the 14,000 ± 500-foot altitude (plus 2.00-second delay).

Components

In the following paragraphs, some of the various components used on the ESCAPAC 1 ejection seat are discussed. This descriptive information is to be used only for studying purposes, as only the applicable Maintenance Instructions Manuals are to be used to perform aircraft maintenance.

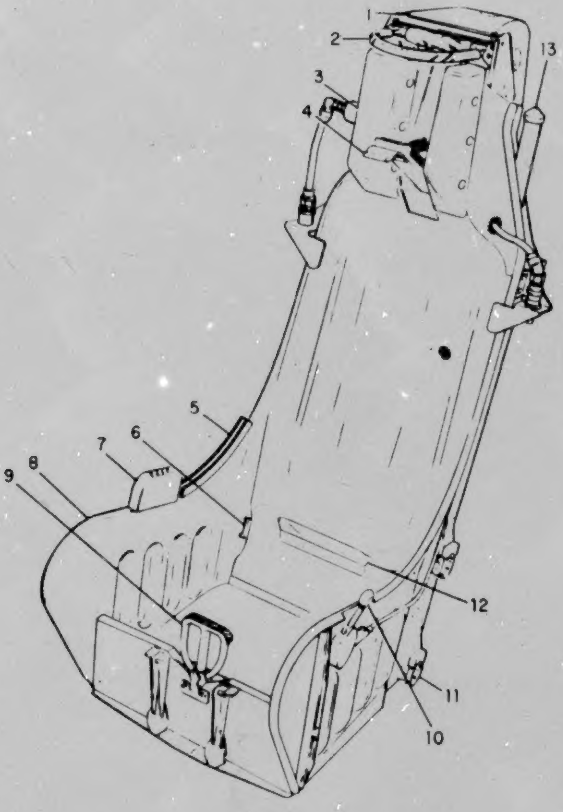
SEAT ASSEMBLY.–The seat assembly is a lightweight aluminum structure offering maximum comfort and protection. The seat assembly incorporates a firing control disconnect assembly located at the top of the seat, and a face curtain ejection control handle assembly at the top forward portion of the seat headrest. The secondary ejection control handle is located on the front center part of the seat bucket. Figures 8-41 and 8-42 show the ESCAPAC ejection seat. Frequent reference should be made to these figures as other components of the ejection seat are discussed.

An ejection control safety handle is contained between the two headrest pads; and when in the full down position, both ejection control handles are in the safe condition. A dual strap, power inertia reel is located below the ejection control safety handle and is attached to the survival equipment shoulder harness, which automatically locks to restrain the pilot's forward movement during high deceleration forces. The power inertia reel is controlled, locked or unlocked, by the manual control lever assembly on the left-hand side of the seat bucket.

A manual harness release handle located on the right-hand side of the seat bucket provides for emergency release and normal removal and installation of the survival equipment.

Separation of the pilot/crewman from the seat assembly is accomplished by a separator rocket that propels the seat away from the occupant. A harness release actuator is installed at the right-hand back of the seat structure.

The ejection seat assembly is installed in the aircraft by attaching the upper bracket of the seat structure to the catapult attaching eye. The rocket catapult is attached at the base of the launcher tube to the seat actuator assembly, which is mounted on support brackets. (See fig. 8-55.) Two guide rails, installed in canted



1. Face curtain cover
2. Face curtain ejection control handle
3. Dual headrest pads
4. Ejection control safety lever and handle
5. Parachute arming lanyard channel
6. Harness release fitting (2 places)
7. Harness release handle
8. Leg protecting side supports
9. Secondary ejection control handle
10. Inertia reel manual control lever assembly
11. Roller (6 places)
12. Rubber coated parachute support shelf
13. Separator rocket

Figure 8-41.–ESCAPAC EJECTION SEAT (Front view).

bulkheads, engage three rollers mounted on each side of the ejection seat. This permits proper vertical direction of the seat on the way out of the cockpit and acts as a guide for normal raising or lowering of the seat by the actuator assembly.

Vertical adjustment of the ejection seat is provided by an electrically operated seat actuator located on the lower aft portion of the seat assembly.

EJECTION SEAT SAFETY EQUIPMENT.–The rocket catapult ejection seat contains explosive charges that represent a potential danger to personnel occupied with maintenance of the seat and the equipment contained in the cockpit area. To afford a measure of safety to both personnel and equipment, three safety devices–the pin block assembly (fig. 8-43 (A)), initiator safety pin (fig. 8-43), and rocket seat harness actuator lock assembly (fig. 8-45)–are provided. All safety devices must be in place and properly positioned when the aircraft is on the ground.

The ejection control safety latch handle, located in headrest also provides additional protection against inadvertent firing of the rocket charge and subsequent seat ejection. Figures 8-43 and 8-45 show the safety devices for the rocket catapult ejection seat.

All safety devices, except those integrated into the seat construction, are provided with red streamers. Before entering the cockpit for maintenance purposes, all safety equipment must be visually checked to make certain that each item is installed and secured. All personnel entering the cockpit area must be properly instructed in the use of the safety equipment and warned of the highly dangerous nature of the explosives contained in the rocket catapult ejection seat.

Interlock Cam and Pin Assembly.–The interlock cam and pin assembly is located on the left side of the canted bulkhead. Its purpose is to prevent seat ejection prior to canopy jettison and accidental rocket detonation during maintenance operations. Figure 8-44 shows the interlock cam and pin assembly.

The pin is spring-tensioned and attached to a cable and a retainer. The retainer has a swaged end fitting that is held in the firing control disconnect housing detent hole by the firing control disconnect pin. The aft portion of the interlock pin protrudes through a hole in the interlock support and is held in place by the interlock cam.

The interlock cam and pin assembly, suspended from the rigid interlock support to the firing control disconnect housing, holds the firing control disconnect assembly in position and eliminates the possibility of firing the rocket catapult prior to canopy jettison. The interlock cam and pin assembly prevents the disconnect housing from being pulled forward to the fired position, thus making it impossible to fire the catapult rocket until the interlock cam and pin assembly are separated.

In the normal ejection sequence, an M99 initiator supplies ballistic gases to the pneumatic bungee, which jettisons the canopy and pulls the cam from the pin assembly as the canopy clears the ejection path. The interlock actuator assembly, now free of the cam, allows further pull on the control handle, which fires two M99 initiators and supplies gases to initiate the rocket catapult.

Ejection Control Safety Handle.–The ejection control safety handle is installed between two rubber headrest pads on the forward portion of the seat assembly. Its purpose is to lock the firing control disconnect assembly to prevent inadvertent actuation of components that govern seat ejection. Figure 8-45 shows the ejection control safety handle.

For easy identification, the ejection control safety handle bears a decal, stenciled in yellow and black, which reads: "PULL OUT TO SAFETY EJECTION CONTROLS." When the ejection control safety handle is moved to the down position, a cam attached to a safety rod is actuated, forcing the control safety rod upward and into the ground safety socket. All ejection movements of the firing control disconnect assembly are terminated.

To secure the pin (safety rod) in the locked position, a safety lock is incorporated in the handle assembly (See fig. 8-45.) When the handle is pulled down, the safety lock, which is spring loaded at the pivot point, moves upward to engage a stop attached to the seat structure. Movement of the ejection control safety handle to the up position cannot be accomplished until the safety lock is manually depressed to disengage the lock from the stop.

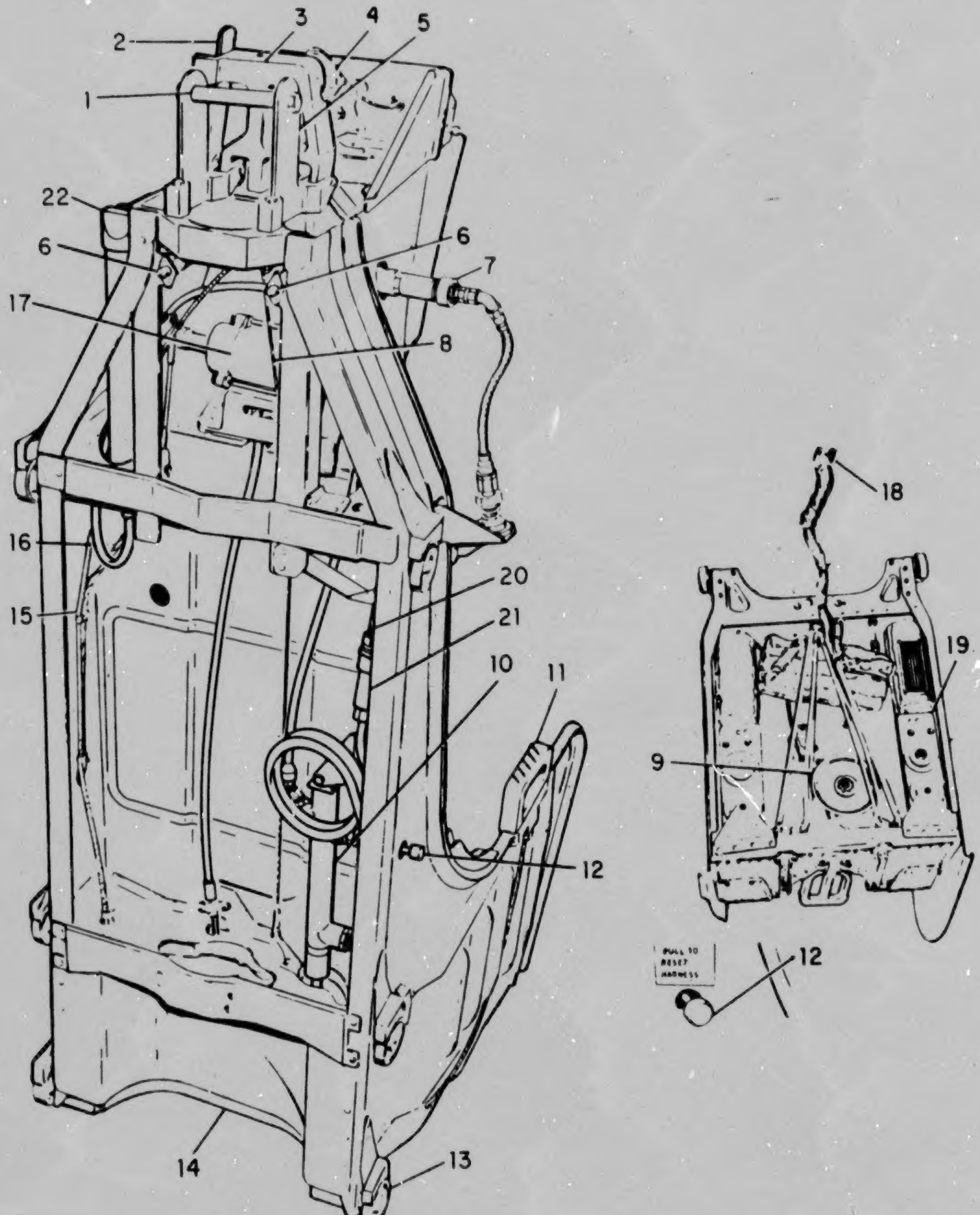
The safety lock is visible only when the ejection control safety handle is in the down position. Its upper surface is covered with a decal in a black and yellow checkerboard pattern to provide visual verification that the ejection controls are safely secured in the locked position.

ROCKET CATAPULT MK 13 MOD 1 OR 2.–The Rocket Catapult Mk 13 Mod 1 or 2 is a self-contained, gas-initiated rocket designed to eject the pilot and seat from the aircraft. The rocket catapult is installed in the rear of the seat assembly and is illustrated in figure 8-46. Actuation of the rocket catapult is accomplished by the pilot when the face curtain or secondary control handle is pulled.

When either control handle is pulled, an M99 initiator is fired and the ballistic gases created by this cartridge cause the power inertia reel cartridge to be fired and jettison the canopy, which removes the interlock cam and pin assembly. Continued pull of the control handle

NOMENCLATURE FOR FIGURE 8-42.

1. **Rocket catapult-seat attachment bolt**
2. **Catapult firing control**
3. **Firing controls disconnect assembly**
4. **Face curtain RH control cable**
5. **Catapult support bracket assembly**
6. **Catapult initiator firing rods**
7. **Power inertia reel cartridge**
8. **Firing control disconnect cable**
9. **Secondary ejection control disconnect pulley assembly**
10. **Harness release actuator**
11. **Harness release handle**
12. **Harness release actuator manual detent pin**
13. **Roller (6 places)**
14. **Rocket catapult blast shield**
15. **Secondary ejection control cable**
16. **Inertia reel manual control cable**
17. **Shoulder harness inertia reel assembly**
18. **Floor attaching fitting**
19. **Seat stabilization system**
20. **MK 12 mod O initiator**
21. **M53 initiator**
22. **Separator rocket**


3
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PULL TO RESET HARNESS
12
14
13

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Figure 8-42.—ESCAPAC EJECTION SEAT (Rear view).

fires the two M99 initiators, introducing pressurized gases into the firing system of the catapult tube, which initiates the action of the firing pin.

The firing pin strikes a primer which fires a cartridge in the base of the catapult tube. The gas pressure actuates the locking ring, which releases the catapult actuator. As the rocket tube and ejection seat are lifted upward on the guide rails, the rocket tube causes the sleeve unlock shear pin to shear. The sleeve strips the piston from the nozzle, and the hot gases ignite the propellant in the rocket tube. The rocket tube separates from the catapult tube and continues to propel the seat and pilot upward. Figure 8-47 shows the rocket catapult during a functional operation.

EJECTION SEAT STABILIZATION SYSTEM.–The ejection seat stabilization system counteracts the adverse effects of aerodynamics and seat system dynamic center of gravity variation. The stabilization system limits the maximum rotational rates to acceptable values, and provides consistent and predictable trajectory shapes.

The stabilization system is installed in the underside of the seat bucket and consists of two brake units, a deployable bridle arrangement, and four nylon drag lines. Portions of the system lines are stowed in two fabric pouches mounted on the seat and are routed through the brake units and the eye of the bridle. The remaining lengths of the system lines, at the eye of the bridle, are gathered and covered with a flame retardant sleeve. The covered section of the line is stowed in a deployment pouch, and the end is attached to the aircraft floor structure.

As the seat ejects, the slack line stowed in the deployment pouch pays out and the bridle drops into position. At a preprogramed distance, the system lines are pulled through the brake units, developing a preprogramed force in the lines. This counteracts any adverse rotation of the seat. Figure 8-48 shows the ejection seat stabilization system in use.

HARNESS RELEASE AND SEPARATION SYSTEM.–The harness release and separation system equipment (fig. 8-49) incorporated in the ESCAPAC ejection seat provides the pilot with a fully automatic separation from the seat after ejection.

The system is actuated by a ballistic type initiator that furnishes energy in the form of pressurized gas to initiate the mechanical action necessary to effect pilot-seat separation. If the system should fail to function automatically, harness release may be accomplished by manually actuating the harness release handle on the right side of the ejection seat bucket.

As the seat and occupant accelerate upward and out of the cockpit during the ejection sequence the harness release actuator (fig. 8-50) initiates the separation sequence. The harness release actuator consists of a vertical chamber that houses the clevis and piston assembly. The harness release actuator performs three functions when the M53 cartridge is fired; actuation of the firing controls disconnect assembly (fig. 8-51), positioning of the bellcrank assembly, and firing the man/seat separator rocket.

As the M99 initiators are fired, the resultant gas pressure fires the Mk 12 Mod 0 0.75-second time delay initiator and fires the rocket catapult. After a 0.75-second time delay, the Mk 12 Mod 0 initiator fires the M53 booster initiator that drives the piston upward into the actuator. The clevis assembly at the lower end of the piston strikes the firing control disconnect actuating arm during piston upward travel and actuates the firing control disconnect assembly freeing the actuated firing control. The bellcrank assembly, connected to the clevis, is rotated and positions the bellcrank in a released position, releasing the two lap belt pins and shoulder harness release pins.

The piston assembly, when actuated by the M53 initiator, travels the full length of the chamber of the actuator, allowing pressurized gas to travel through the outlet port of the actuator to the man/seat separation rocket firing the rocket. The piston assembly is locked by the two locking dogs at the full travel position. This condition insures that the lap belt pins and the shoulder harness pin remain retracted and that the piston does not move downward, causing the

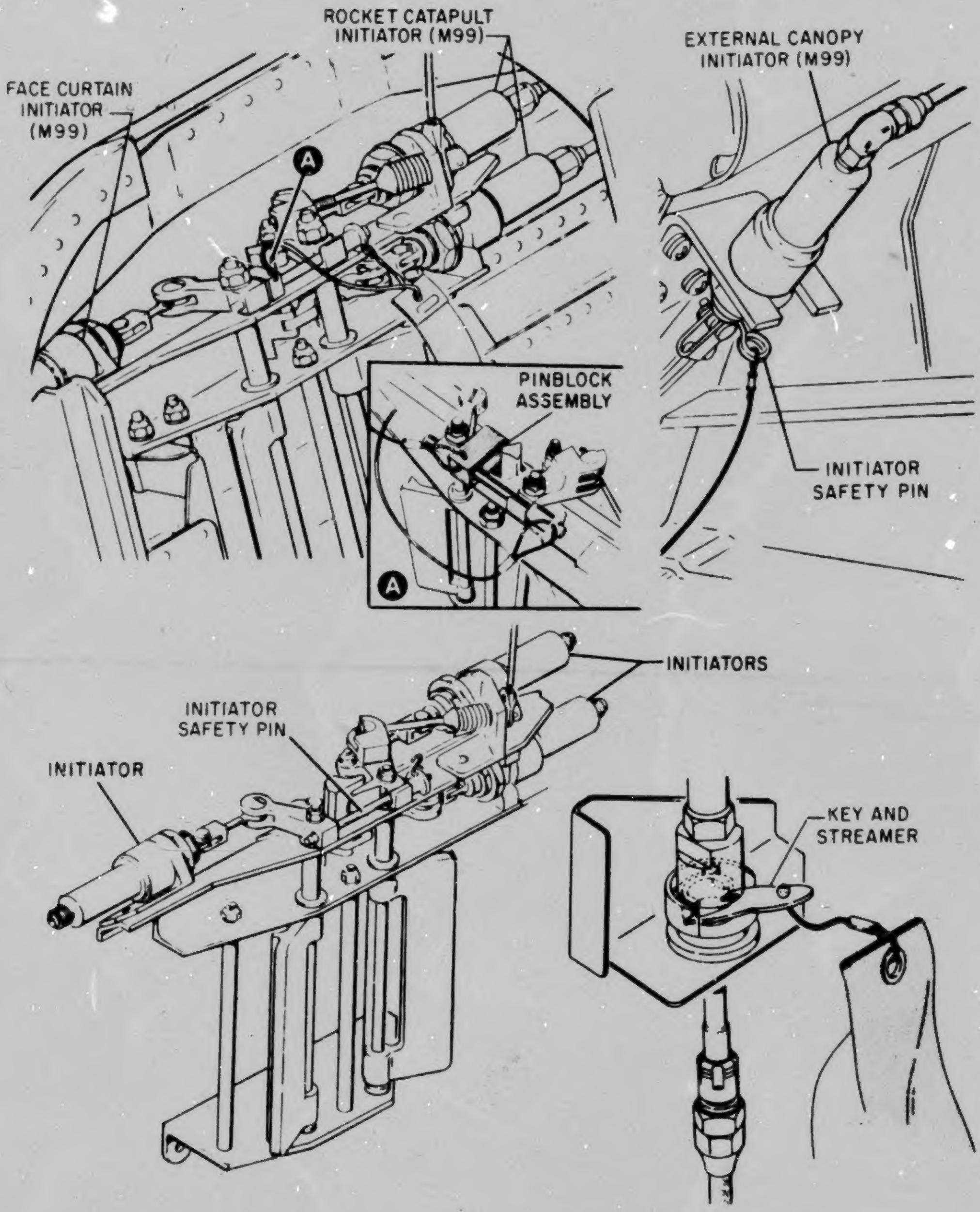
ROCKET CATAPULT INITIATOR (M99)
FACE CURTAIN INITIATOR (M99)
A
EXTERNAL CANOPY INITIATOR (M99)
PINBLOCK ASSEMBLY
A
INITIATOR SAFETY PIN
INITIATORS
INITIATOR SAFETY PIN
INITIATOR
KEY AND STREAMER

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Figure 8-43.–Ejection seat safety equipment (installed).

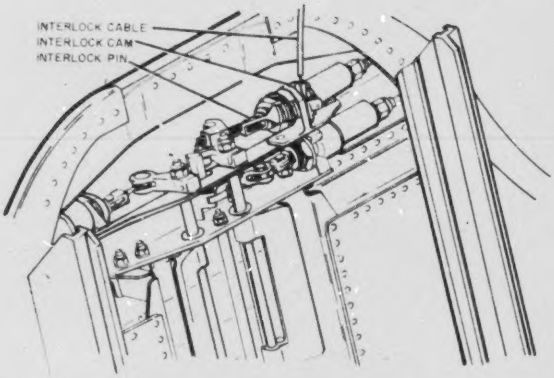

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Figure 8-44.—Interlock cam and pin assembly.

bellcrank to relock the shoulder harness and lap belt pins.

The harness release actuator can be partially actuated by the harness release handle on the right-hand arm of the ejection seat. When the handle, which is attached by cable to the bellcrank assembly, is pulled, the piston is moved upward into the actuator chamber. The piston will stay in the partially up position, held by the manual detent pin located at the upper end of the actuator. When the manual detent pin is pulled, a return spring repositions the piston and bellcrank in the normal position.

The harness release actuator piston and clevis assembly (fig. 8-50) consists of a steel piston located within the harness release actuator and attached to a clevis at the base of the piston. A support for the locking dogs within the actuator is provided near the bottom of the piston rod, where the diameter decreases and is tapered. As the piston rises within the harness release actuator, the clevis strikes the actuating arm of the firing control disconnect assembly. The bellcrank is bolted to the clevis and moves with the clevis as the harness release actuator is fired. As the harness release handle on the right-side of the seat pan is pulled upward, the clevis and piston rise within the actuator and are held in the harness release position by the harness release actuator manual detent pin.

Firing Control Disconnect Assembly.—The firing control disconnect assembly is located aft of the face curtain control handle and consists of a firing control disconnect assembly, a safety lockpin, and a cable assembly. The face curtain control handle cables and the secondary ejection control handle cable are attached to the disconnect assembly and actuate the assembly when pulled. The disconnect assembly provides the necessary action to actuate the inertia reel assembly and the rocket catapult M99 initiators. Figure 8-51 shows the firing control disconnect assembly.

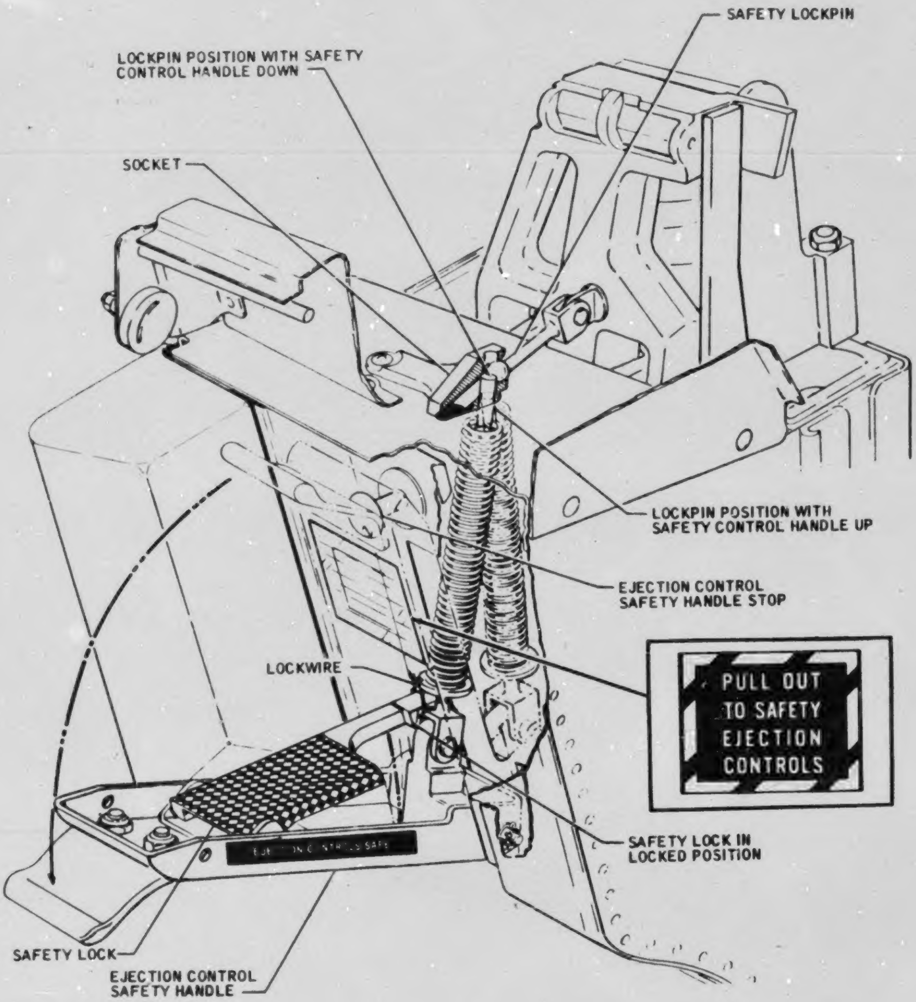
The firing control disconnect assembly controls both the firing of the rocket catapult and the release of the face curtain and/or the secondary ejection control handle cables from the seat during ejection. As the canopy clears the ejection path, the seat-canopy interlock is removed, allowing the firing control disconnect assembly to pivot forward and actuate the initiator firing rods. The firing rods actuate the M99 initiator, causing the power inertia reel to retract and position the pilot for proper ejection, and the catapult fires.

As the seat moves up the guide rails, the harness release actuator is fired. This releases the lap belt and shoulder harness pins. A clevis on the piston contacts the firing control disconnect arm.

Its downward movement pulls the firing control disconnect cable and withdraws the spring-loaded firing control disconnect pin on the upper end of the disconnect cable. Withdrawal of the disconnect pin, in the firing control disconnect housing, releases the firing control release fitting and both control handles disconnect. The pilot is completely disconnected from the seat while maintaining a grip on either ejection control handle.

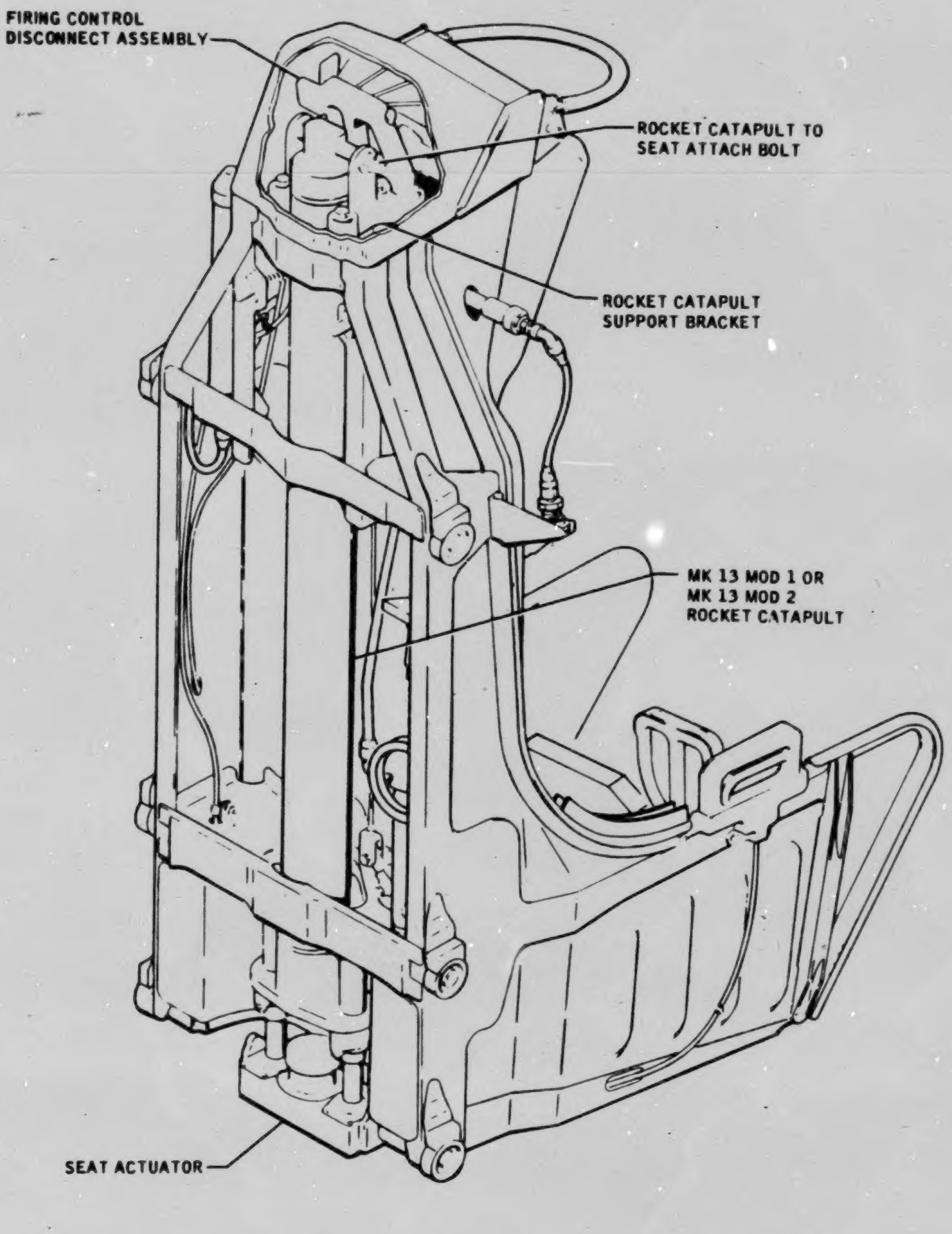
The firing control safety lockpin is channeled into the ground safety socket. When the ejection control safety handle is pulled down, the safety lockpin rests against the safety handle lockpin, preventing movement of the firing control disconnect assembly.

Harness Release Bellcrank Assembly.—The harness release bellcrank assembly, shown in figure 8-52, is located on the lower back of the


SAFETY LOCKPIN
LOCKPIN POSITION WITH SAFETY CONTROL HANDLE DOWN
SOCKET
LOCKPIN POSITION WITH SAFETY CONTROL HANDLE UP
EJECTION CONTROL SAFETY HANDLE STOP
LOCKWIRE
PULL OUT TO SAFETY EJECTION CONTROLS
EJECTION CONTROLS SAFE
SAFETY LOCK IN LOCKED POSITION
SAFETY LOCK
EJECTION CONTROL SAFETY HANDLE

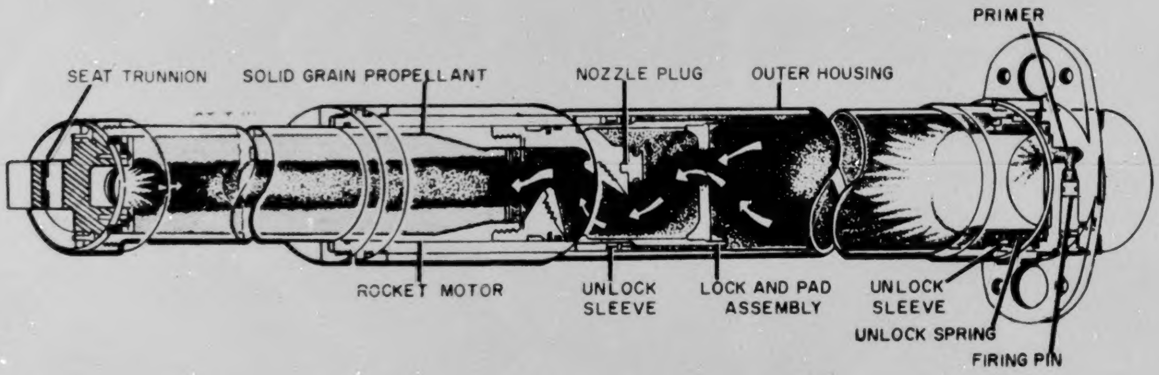
AM.666

Figure 8-45.–Ejection control safety handle.


FIRING CONTROL
DISCONNECT ASSEMBLY
ROCKET CATAPULT TO
SEAT ATTACH BOLT
ROCKET CATAPULT
SUPPORT BRACKET
MK 13 MOD 1 OR
MK 13 MOD 2
ROCKET CATAPULT
SEAT ACTUATOR

AM.629

Figure 8-46.—Rocket catapult Mk 13 Mod 1 or 2 (installed).



AM.667

Figure 8-47.—Rocket Catapult Mk 13 Mod 1 or 2—Functional operation.

seat structure and is for initiating the pilot release system. The harness release bellcrank assembly consists of a multiple-arm leverage assembly containing attachments which immediately sever all connections of the seat from the pilot when the harness release actuator is fired.

When the harness release actuator cartridge is fired, the piston is impelled upward, rotating the bellcrank and actuating mechanical linkage to provide release of both the lap belt and the shoulder harness inertia reel straps. The entire mechanism is secured, after actuation, by the locking dogs located in the lower portion of the harness release actuator.

NOTE: Whenever the cartridge in the harness release actuator is inadvertently fired during maintenance, the harness release actuator assembly must be overhauled.

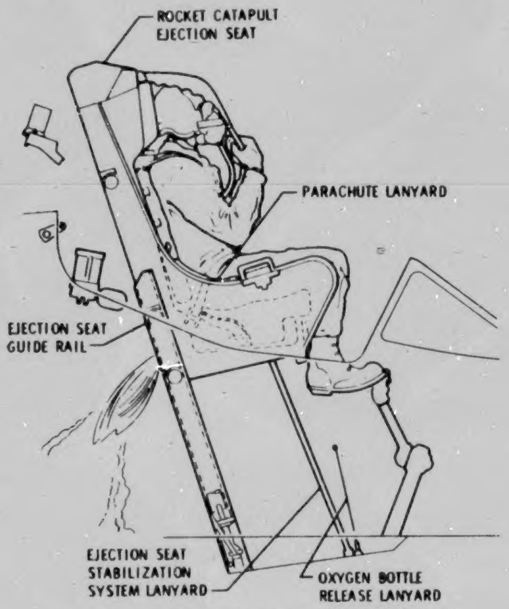
Actuation of the bellcrank may also be effected through the harness release handle on the right-hand side of the seat assembly. The handle, when pulled upward, moves the bellcrank to the release position, forcing the clevis upward into the harness release actuator manual detent pin. Manually pulling the detent pin, which protrudes from the right-hand side of the seat assembly, resets the entire mechanism in the normally locked position.

Shoulder Harness Disconnect Cable Assembly. The shoulder harness disconnect cable assembly provides a means of securing the shoulder harness inertia reel straps to the seat structure. The upper end of the cable assembly is attached to a pin that is normally contained in a recess located in the seat structure. The lower end of the cable is attached to the bellcrank assembly. When the bellcrank is rotated, the cable pulls the pin downward sufficiently to release the inertia reel dual strap fittings.

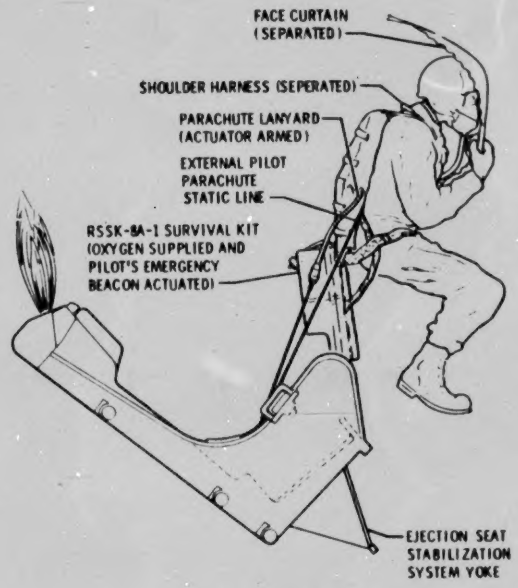
Two holes located in the back of the seat structure permit a direct vertical attachment of the cable from the pin to the bellcrank. The cable is routed from the pin through a hole located below the pilot's headrest. The cable travels down the forward side of the seat back, passing through the hole at the lower end of the seat back, and is attached to an arm on the bellcrank assembly.

The shoulder harness disconnect cable pin is normally in a locked position; and as the seat is ejected, the delay cartridge fires and repositions the bellcrank to draw the shoulder harness disconnect pin downward.

As the inertia reel pin is withdrawn, it frees the inertia reel straps, allowing the straps to pull through the parachute roller fittings into the inertia reel. The pilot is now free of any attachment to the seat and separation is accomplished. Figure 8-53 shows the shoulder harness disconnect assembly along with the inertia reel assembly.


ROCKET CATAPULT EJECTION SEAT
PARACHUTE LANYARD
EJECTION SEAT GUIDE RAIL
EJECTION SEAT STABILIZATION SYSTEM LANYARD
OXYGEN BOTTLE RELEASE LANYARD

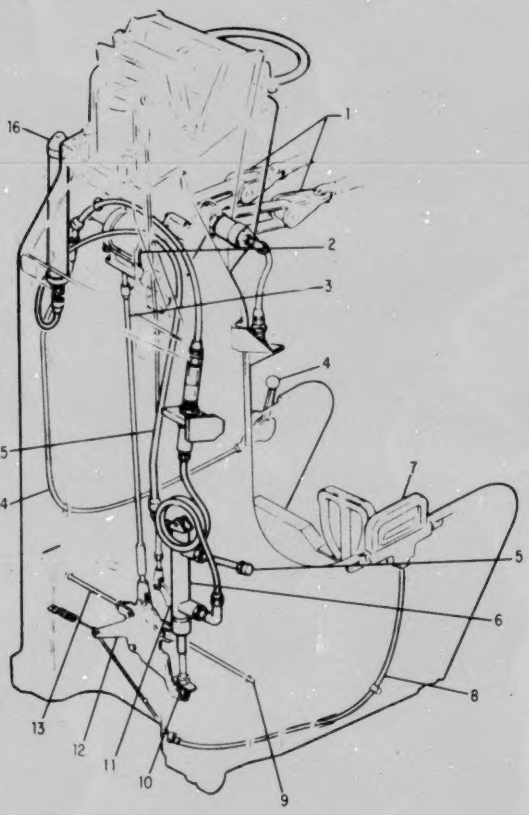
(A) LANYARDS DURING INITIAL EJECTION


FACE CURTAIN (SEPARATED)
SHOULDER HARNESS (SEPERATED)
PARACHUTE LANYARD (ACTUATOR ARMED)
EXTERNAL PILOT PARACHUTE STATIC LINE
RSSK-8A-1 SURVIVAL KIT (OXYGEN SUPPLIED AND PILOT'S EMERGENCY BEACON ACTUATED)
EJECTION SEAT STABILIZATION SYSTEM YOKE

(B) SEAT-PILOT SEPERATION

AM.630

Figure 8-48.—Ejection seat stabilization and seat-pilot separation.



AM.631

1. Parachute roller fitting
2. Shoulder harness inertia reel assembly
3. Shoulder harness disconnect cable
4. Inertia reel manual control lever assembly
5. Harness release manual detent pin
6. Harness release actuator assembly
7. Harness release handle
8. Harness release cable assembly
9. Right-hand lap belt pin
10. Clevis assembly
11. Firing control disconnect actuating arm
12. Bellcrank assembly
13. Left-hand lap belt pin
14. Inertia reel manual control lever cable
15. Separator rocket flex hose assembly
16. Separator rocket

Figure 8-49.—Harness release and separation system components.

Shoulder Harness Power Inertia Reel Assembly.–The shoulder harness power inertia reel assembly consists of a power inertia reel, located in the lower headrest area of the ejection seat, and of a control lever assembly on the left-hand side of the seat pan. The inertia reel is cartridge actuated to withdraw the shoulder harness during ejection.

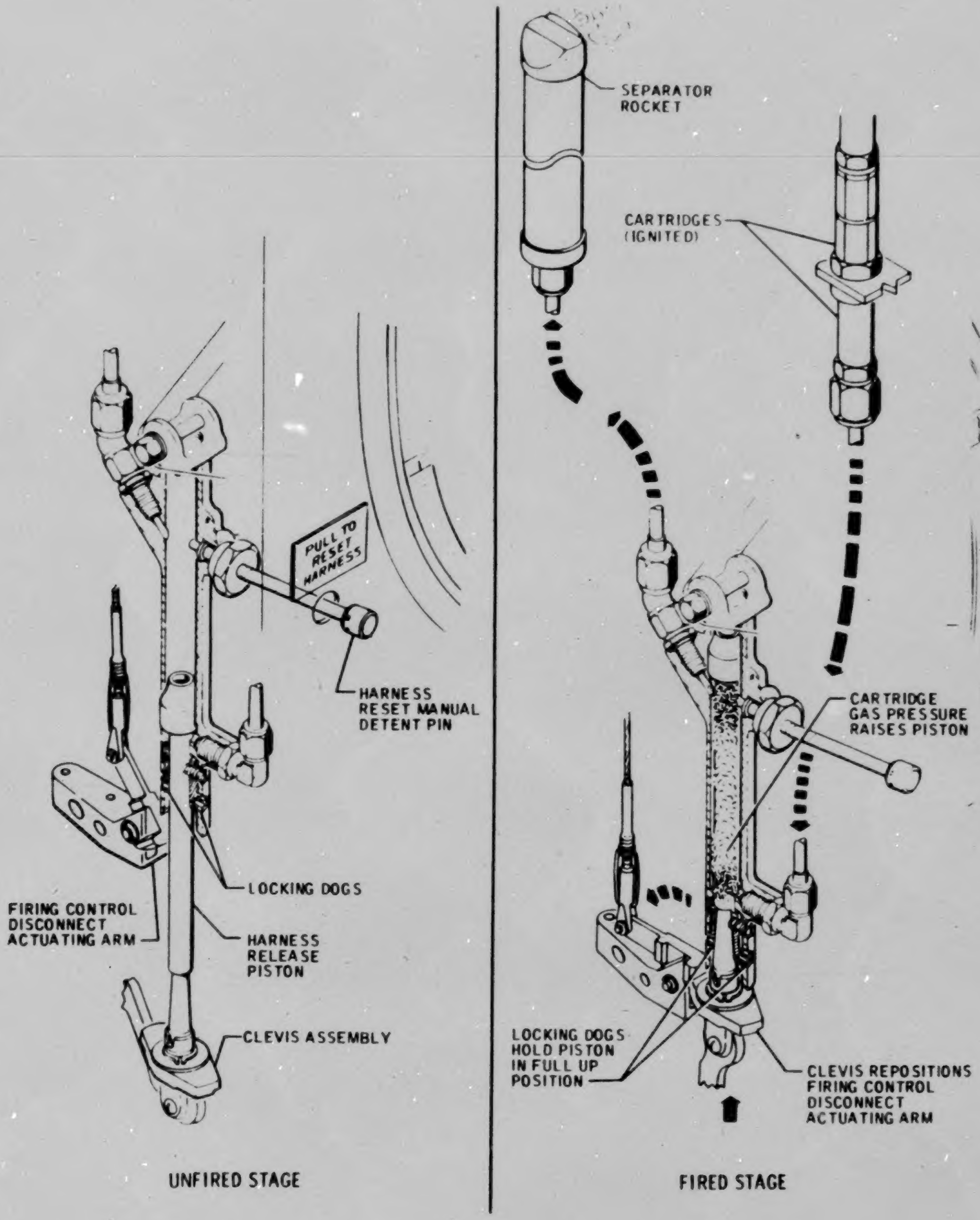
A flexible cable couples the inertia reel and control lever and permits manual locking and unlocking of the inertia reel. The harness reel straps are latex- treated, prestretched dacron webbing.

Normally, the power inertia reel will extend or retract as required by pilot/ crewman movement. However, when the aircraft encounters an excessive g-force that tends to throw the pilot from the seat, such as a crash landing, the reel automatically locks the shoulder harness regardless of the pilot's position. This locking action prevents further harness extension, but permits the pilot to return to the normal sitting position and, at the same time, maintains its locking action.

NOTE: The power inertia reel cannot be extended after the power portion has been fired. After the power inertia reel has been fired for any reason, it must be overhauled.

Inertia Reel Manual Control Lever Assembly.–The inertia reel manual control lever assembly, also shown in figure 8-53, is located on the left-hand side of the seat bucket and consists of a spring-tensioned lever with two designated positions– LOCKED or UNLOCKED. The control assembly provides manual selection of the LOCKED or UNLOCKED condition without affecting the automatic locking feature for excessive g-forces or the proper positioning of the pilot in the seat during ejection.

Under normal conditions, the control assembly lever is placed in the LOCKED position for takeoff and landing, and in the UNLOCKED position during normal flight for greater freedom of movement. During adverse flying conditions, the inertia reel can be locked by placing the control lever in the LOCKED position. Locking the inertia reel prevents extension of the harness straps and secures the pilot firmly against the seat back. Quick retraction of the harness straps will not affect the locked or

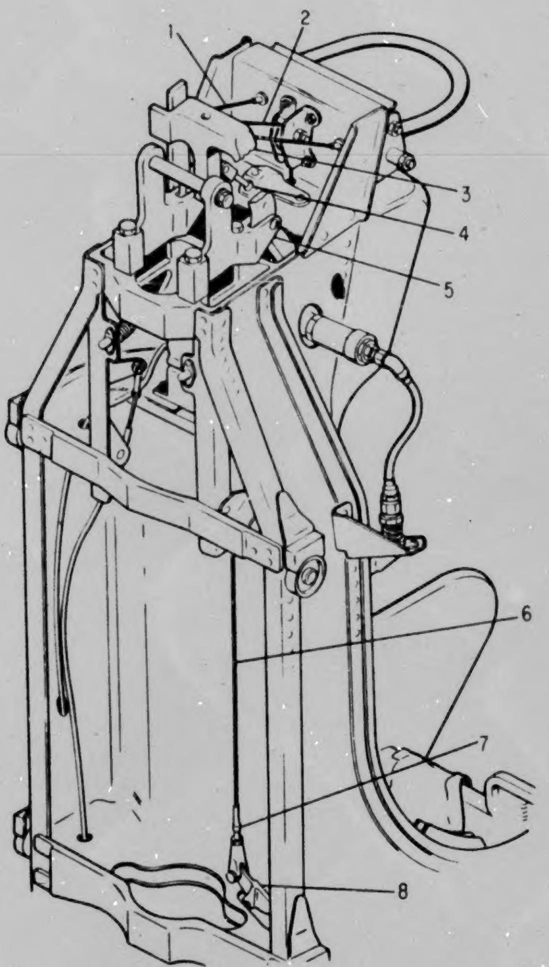

PULL TO RESET HARNESS
HARNESS RESET MANUAL DETENT PIN
LOCKING DOGS
FIRING CONTROL DISCONNECT ACTUATING ARM
HARNESS RELEASE PISTON
CLEVIS ASSEMBLY
SEPARATOR ROCKET
CARTRIDGES (IGNITED)
CARTRIDGE GAS PRESSURE RAISES PISTON
LOCKING DOGS HOLD PISTON IN FULL UP POSITION
CLEVIS REPOSITIONS FIRING CONTROL DISCONNECT ACTUATING ARM

UNFIRED STAGE

FIRED STAGE

AM.632

Figure 8-50.—Harness release actuator.



1. Face curtain cable.
2. Secondary firing control cable.
3. Firing controls.
4. Safety lock pin.
5. Catapult support.
6. Firing controls disconnect cable assembly.
7. Terminal fitting.
8. Firing control disconnect actuating arm.

Figure 8-51.–Firing control disconnect assembly.

unlocked attitude of the reel. Cycling of the manual control lever from UNLOCKED to LOCKED and back to UNLOCKED will release an inertially induced locked condition of the inertia reel.

Harness Release Handle.–The harness release handle, shown in figure 8-54, is located in a holder on the right-hand side of the seat assembly and provides a means of manually releasing all restraining components of the ejection seat by partially actuating the bellcrank assembly. This is a metal rectangular-shaped handle which houses a release clip. In the lower portion of the handle is a spring and pin assembly which positions and locks the parachute arming lanyard cable in place.

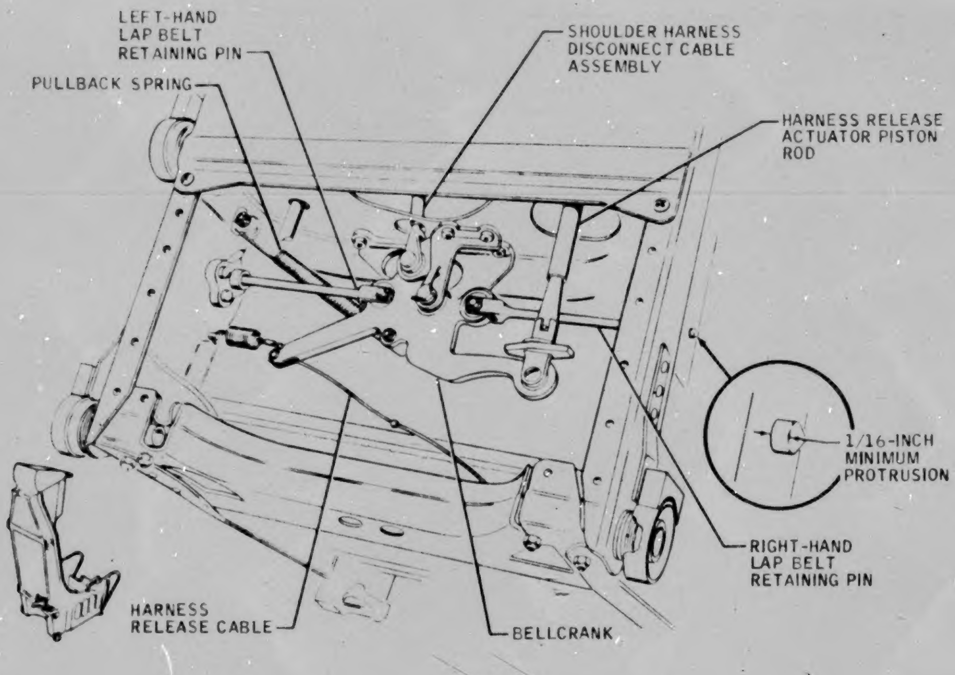
The handle base forms a holder for a cable which runs down the seat and aft to the left-hand side arm of the bellcrank. The cable is held in place with a swaged ball fitting attached by a spring to the left-hand side of the seat structure. A metal stop housing, attached to the lower shelf of the seat assembly, holds the flexible cable in position. It also provides a stop for the swaged cable fitting and limits travel of the manual harness release system.

As the release clip within the handle is raised, the parachute arming lanyard is released; as the handle itself is raised, the cable is pulled upward, which, in turn, pulls the left arm of the bellcrank downward. Downward movement of the left arm raises the actuator piston upward into the harness release actuator.

At the same time, the bellcrank retracts the left-hand and right-hand lap belt pins and the shoulder harness pin attachments. The piston, which moves upward into the harness release actuator, is locked in the release position by the manual detent pin on the right-hand side of the actuator. To prevent further travel upward when the harness release handle is used, a swaged fitting, attached to the harness release handle cable assembly, positions itself against the metal stop holder on the lower shelf of the seat.

To reposition the handle into the seat assembly holder, the manual detent pin must be pulled outboard to reset the bellcrank, which resets the harness release cable assembly.

SEAT ADJUSTMENT SYSTEM.–The ESCAPAC rocket catapult ejection seat may be adjusted to provide comfort and to ac-


LEFT-HAND LAP BELT RETAINING PIN
PULLBACK SPRING
SHOULDER HARNESS DISCONNECT CABLE ASSEMBLY
HARNESS RELEASE ACTUATOR PISTON ROD
1/16-INCH MINIMUM PROTRUSION
RIGHT-HAND LAP BELT RETAINING PIN
HARNESS RELEASE CABLE
BELLCRANK

AM.672

Figure 8-52.—Harness release bellcrank assembly.

commodate the physical characteristics of any individual who occupies the cockpit. The seat adjustment system consists of a seat actuator assembly, a seat switch, and the electrical circuit to make it operate. Figure 8-55 shows the ejection seat actuator and its component arrangement.

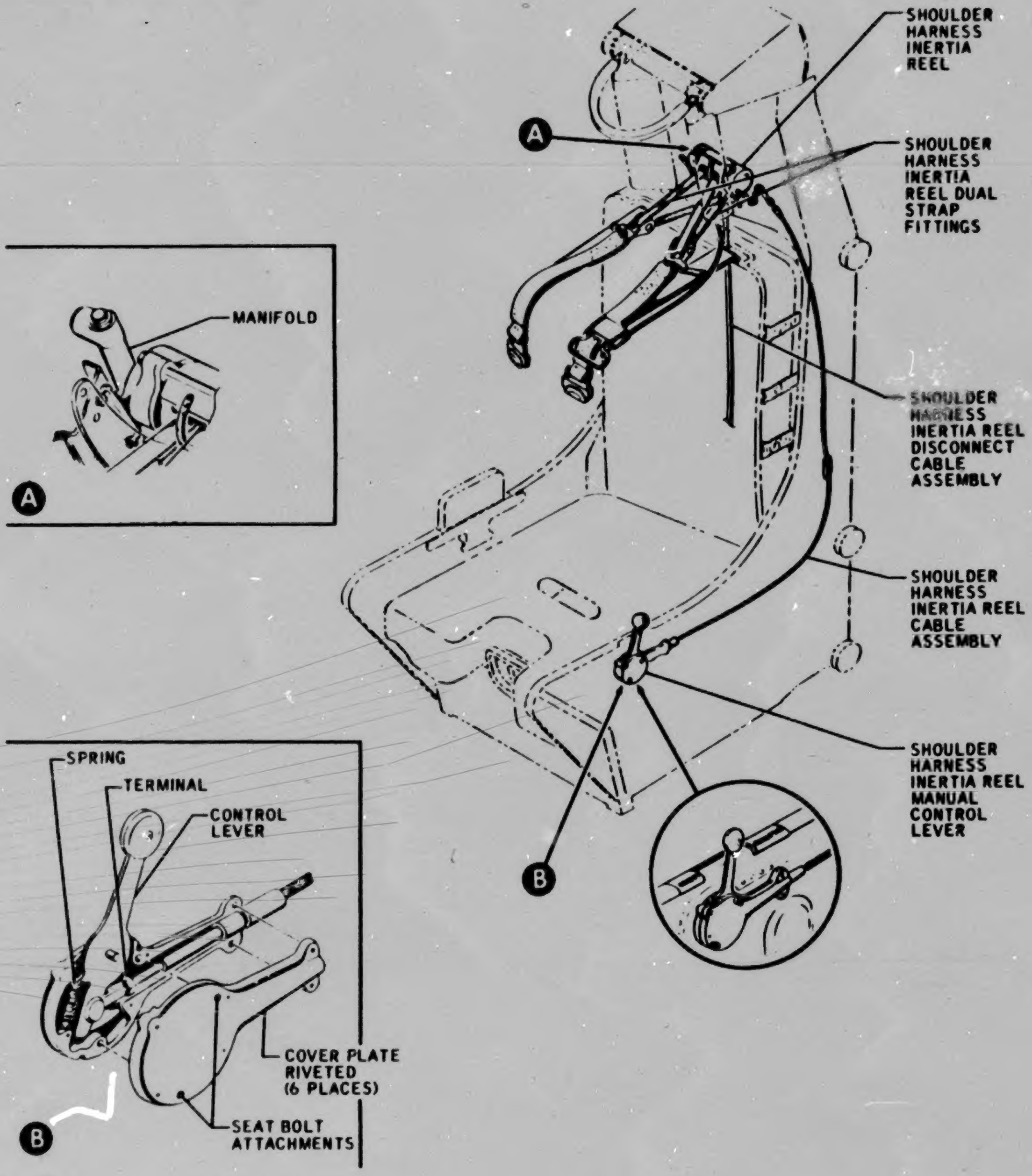
Ejection Seat Actuator Assembly.—The ejection seat actuator assembly is an electrically controlled mechanism which provides a vertical adjustment of the ejection seat position. The assembly is installed on two support fittings attached to the canted bulkhead and consists of a motor, reduction gears, and two vertical drive shafts having matching drive shaft barrels.

The reduction gears between the motor and the drive shafts rotate the shafts at low speed and high torque. Acme threads on each drive shaft engage matching threads on each barrel and, depending on their direction of travel, will raise or lower the barrels. The ejection seat will correspond accordingly.

Direction of seat travel is controlled by a double-pole, double-throw, momentary switch located on a control panel in the cockpit. The switch is identified by the word SEAT imprinted on the panel, and is further identified by the word UP and DOWN. The 3-phase, reversible seat-actuator motor is energized by 115-volt a-c power derived from the aircraft electrical system.

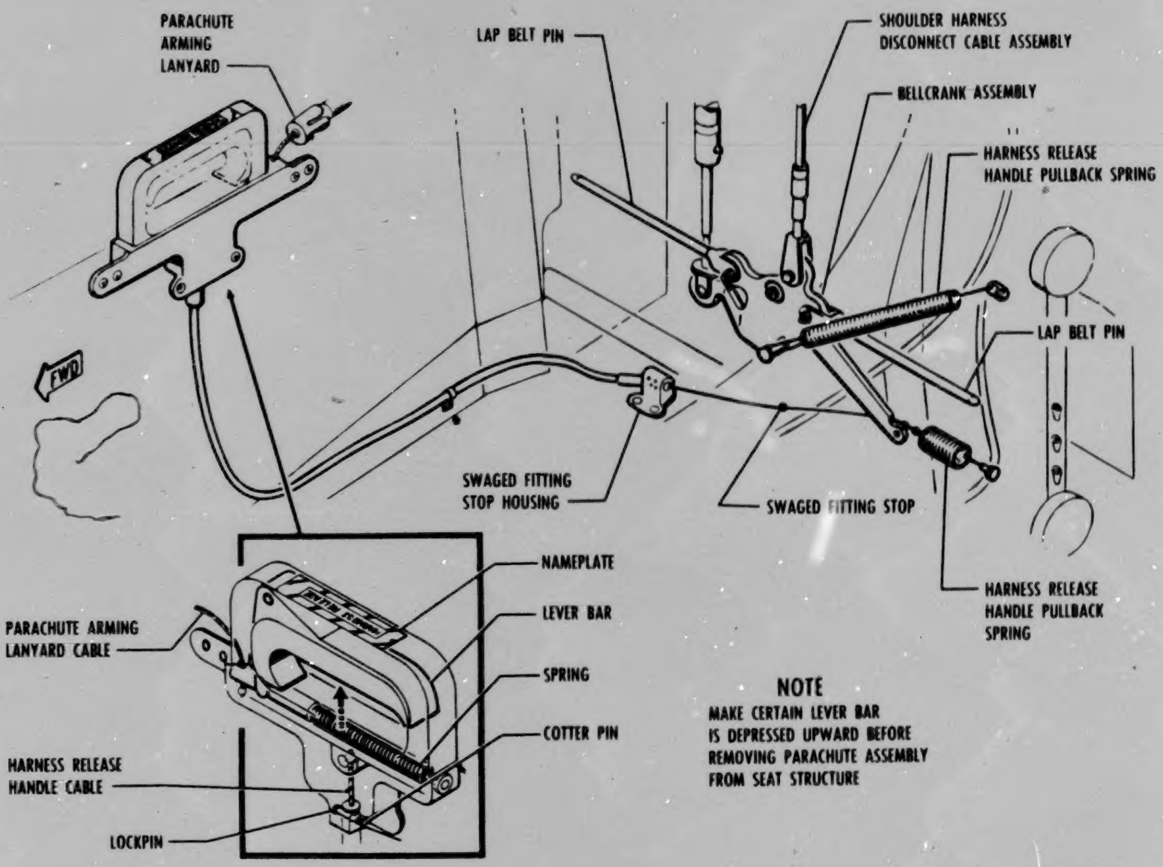
SURVIVAL EQUIPMENT.—The survival equipment, shown in figure 8-56, consists of all equipment used by the pilot (after forcible ejection from the seat has been effected) for permitting a safe return to ground level and, if ejection occurs at sea, for furnishing subsistence until rescue can be accomplished. The survival equipment includes the survival kit and NES-16A parachute assembly.

Upon separation from the rocket catapult ejection seat assembly, the parachute arming lanyard connected to the harness release handle on the right-hand side of the seat structure is


SHOULDER HARNESS INERTIA REEL
A
SHOULDER HARNESS INERTIA REEL DUAL STRAP FITTINGS
MANIFOLD
A
SHOULDER HARNESS INERTIA REEL DISCONNECT CABLE ASSEMBLY
SHOULDER HARNESS INERTIA REEL CABLE ASSEMBLY
SHOULDER HARNESS INERTIA REEL MANUAL CONTROL LEVER
B
SPRING
TERMINAL
CONTROL LEVER
COVER PLATE RIVETED (6 PLACES)
SEAT BOLT ATTACHMENTS
B

AM.1216

Figure 8-53.—Shoulder harness and inertia reel disconnect cable assembly.


PARACHUTE ARMING LANYARD
LAP BELT PIN
SHOULDER HARNESS DISCONNECT CABLE ASSEMBLY
BELLCRANK ASSEMBLY
HARNESS RELEASE HANDLE PULLBACK SPRING
FWD
LAP BELT PIN
SWAGED FITTING STOP HOUSING
SWAGED FITTING STOP
HARNESS RELEASE HANDLE PULLBACK SPRING
NAMEPLATE
PARACHUTE ARMING LANYARD CABLE
LEVER BAR
SPRING
COTTER PIN
HARNESS RELEASE HANDLE CABLE
LOCKPIN

NOTE
MAKE CERTAIN LEVER BAR IS DEPRESSED UPWARD BEFORE REMOVING PARACHUTE ASSEMBLY FROM SEAT STRUCTURE

AM.674

Figure 8-54.—Harness release handle assembly.

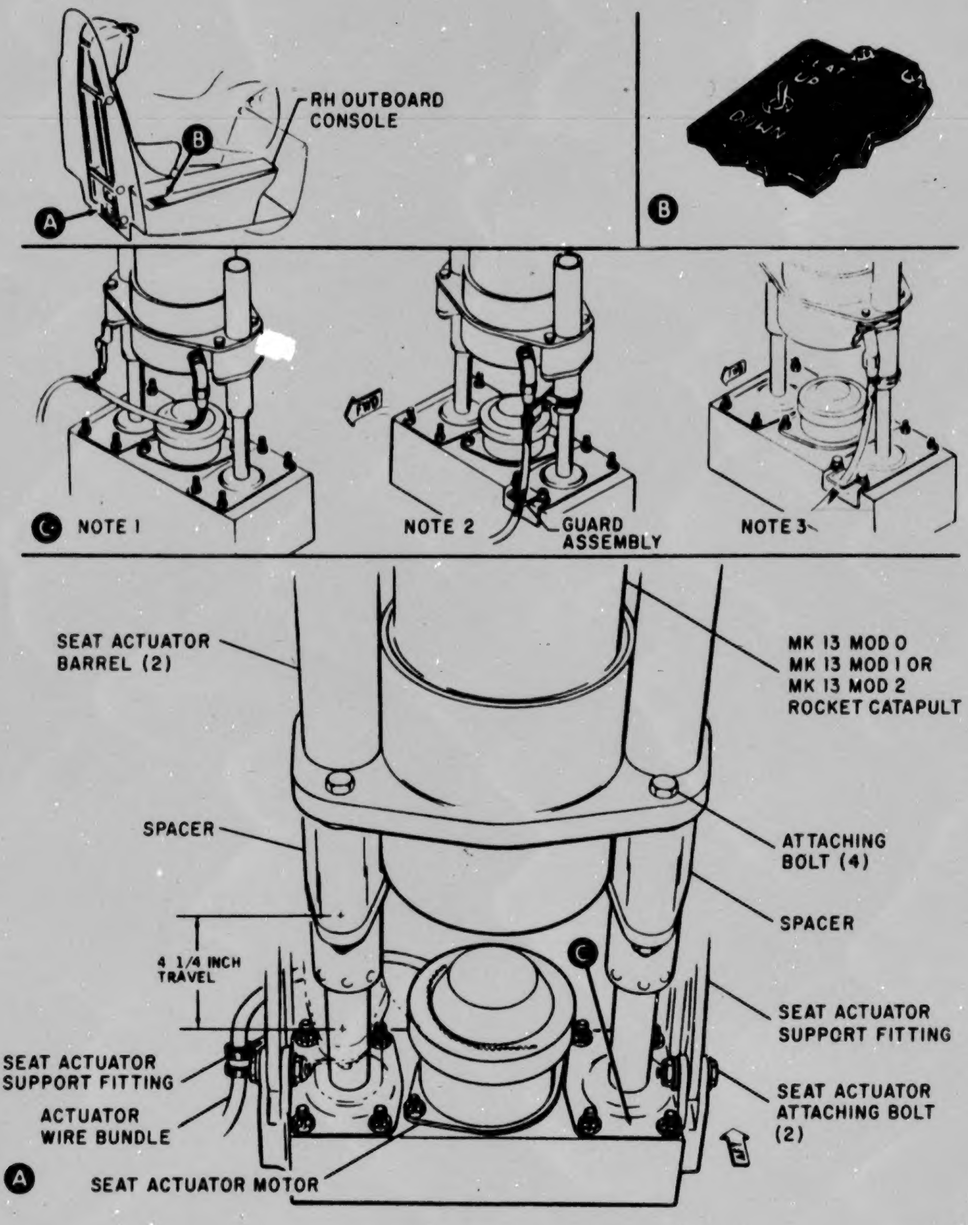
pulled from the parachute, arming the time-delay actuator for parachute deployment. If ejection occurs below the 14,000 (±500) foot altitude level, the parachute will open after a 0.75-second delay; however, if ejection occurs above this altitude, a barometric device in the parachute actuator delays release of the parachute until the pilot has free-fallen to this approximate altitude.

As the seat is ejected, the emergency supply of oxygen, located in the RSSK-8 survival kit assembly, will provide oxygen to the pilot for descent. If the pilot is ejected over water, the RSSK-8 survival kit can be separated by pulling the handle located on the right-hand side of the survival kit. The raft is inflated by manual actuation of the CO_2 bottle.

The RSSK-8 survival kit, which contains emergency provisions to enable the pilot to survive while awaiting rescue, is secured to the pilot's torso suit by nylon webbing straps.

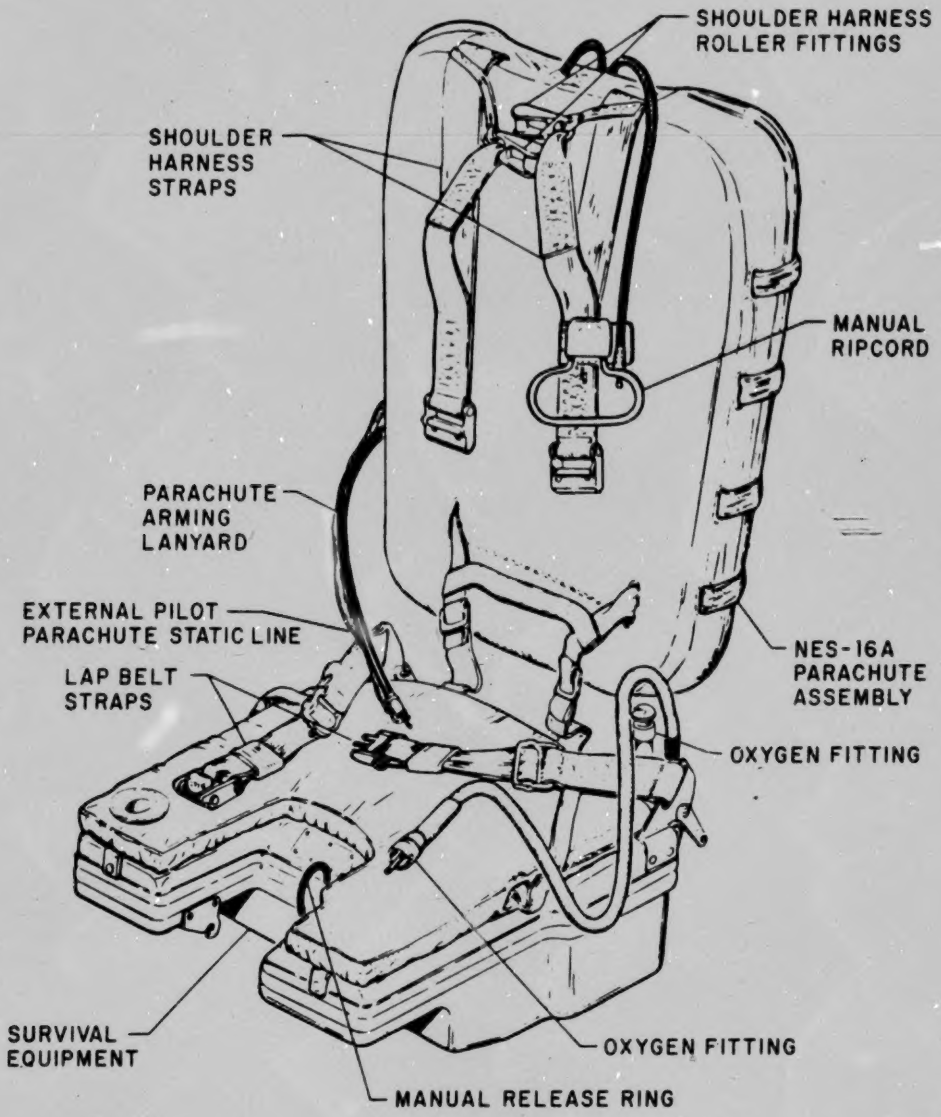
Component Maintenance

Since the seat assembly is designed for one-shot operation in an emergency, it cannot be


RH OUTBOARD CONSOLE
B
A
UP
DOWN
B
C
NOTE 1
NOTE 2
GUARD ASSEMBLY
NOTE 3
SEAT ACTUATOR BARREL (2)
MK 13 MOD 0
MK 13 MOD 1 OR
MK 13 MOD 2
ROCKET CATAPULT
SPACER
ATTACHING BOLT (4)
SPACER
4 1/4 INCH TRAVEL
C
SEAT ACTUATOR SUPPORT FITTING
SEAT ACTUATOR SUPPORT FITTING
SEAT ACTUATOR ATTACHING BOLT (2)
ACTUATOR WIRE BUNDLE
A
SEAT ACTUATOR MOTOR

AM.1217

Figure 8-55.–Ejection seat actuator–component arrangement.


SHOULDER HARNESS ROLLER FITTINGS
SHOULDER HARNESS STRAPS
MANUAL RIPCORD
PARACHUTE ARMING LANYARD
EXTERNAL PILOT PARACHUTE STATIC LINE
NES-16A PARACHUTE ASSEMBLY
LAP BELT STRAPS
OXYGEN FITTING
SURVIVAL EQUIPMENT
OXYGEN FITTING
MANUAL RELEASE RING

AM.1218

Figure 8-56.–Survival equipment.

operationally checked as a unit. However, various components which contribute to the successful functioning of the seat assembly must be operationally checked and tested.

It is the AME's responsibility for checking, testing, and adjusting these various components of the ejection seat as well as for the removal and replacement of cartridges. Through the use of the applicable Maintenance Instructions Manuals, which contain the procedures for testing, adjusting, and checking components, along with diagrams, drawings, and troubleshooting charts, the AME will be able to maintain the ejection seat properly and safely.

The following material contains only typical maintenance practices and must not be used during actual component repair and tests—use only the information contained in the applicable Maintenance Instructions Manual.

FACE CURTAIN HANDLE ASSEMBLY CHECK.—The face curtain handle assembly check is made with the ejection seat removed from the aircraft and the harness actuator lock assembly properly installed and secured on the harness release actuator firing pin sear. Place the seat on a clean suitable work area, position the ejection control safety handle to the full down position, and remove the firing controls cover.

Attach the force gage to the center of the face curtain handle (fig. 8-57, and pull out and slightly down to disengage the handle from the detents. Observe the gage as this is accomplished. The force required to disengage the handle can be found in the appropriate MIM.

To continue with the operational check of the face curtain, push the ejection control safety handle to the full up position and pull the face curtain handle until the safety lockpin bottoms out in the socket. Retract the pin in the firing control disconnect assembly manually and continue pulling the face curtain handle. The face curtain and cable will disengage from the seat.

At the completion of this part of the operational test, the face curtain assembly must be reinstalled in the seat assembly. After the face curtain has been reinstalled, pull the face curtain handle forward out of the detent position and continue to pull until the firing control safety lockpin bottoms out in the socket. Fold the face curtain into accordion pleats and stow the curtain. Compress the firing control handle crossbar manually, and snap into the face curtain handle detent pivots.

Face Curtain Ejection Control Handle Installation.—Upon completion of all tests, the face curtain ejection handle is installed.

Prior to installation, the face curtain is inspected for damage and that the service life of the face curtain has not expired. The manufacture date, first installation date, and inspection and repacked date are all stamped on the upper side of the curtain. In addition, curtain cables are inspected for evidence of kinks, broken wires, or other damages. Any damage to the cables is sufficient reason for cable replacement.

To install the face curtain, place the ejection control safety handle in the full down position and make certain that the cables are correctly connected to the face curtain. Feed the cables through the openings in the curtain assembly stowage compartment, as illustrated in figure 8-57. Pull down on the firing control disconnect cable, and connect the cables to the firing control disconnect assembly (fig. 8-57). Release the firing control disconnect cable and rotate the release fitting until it locks.

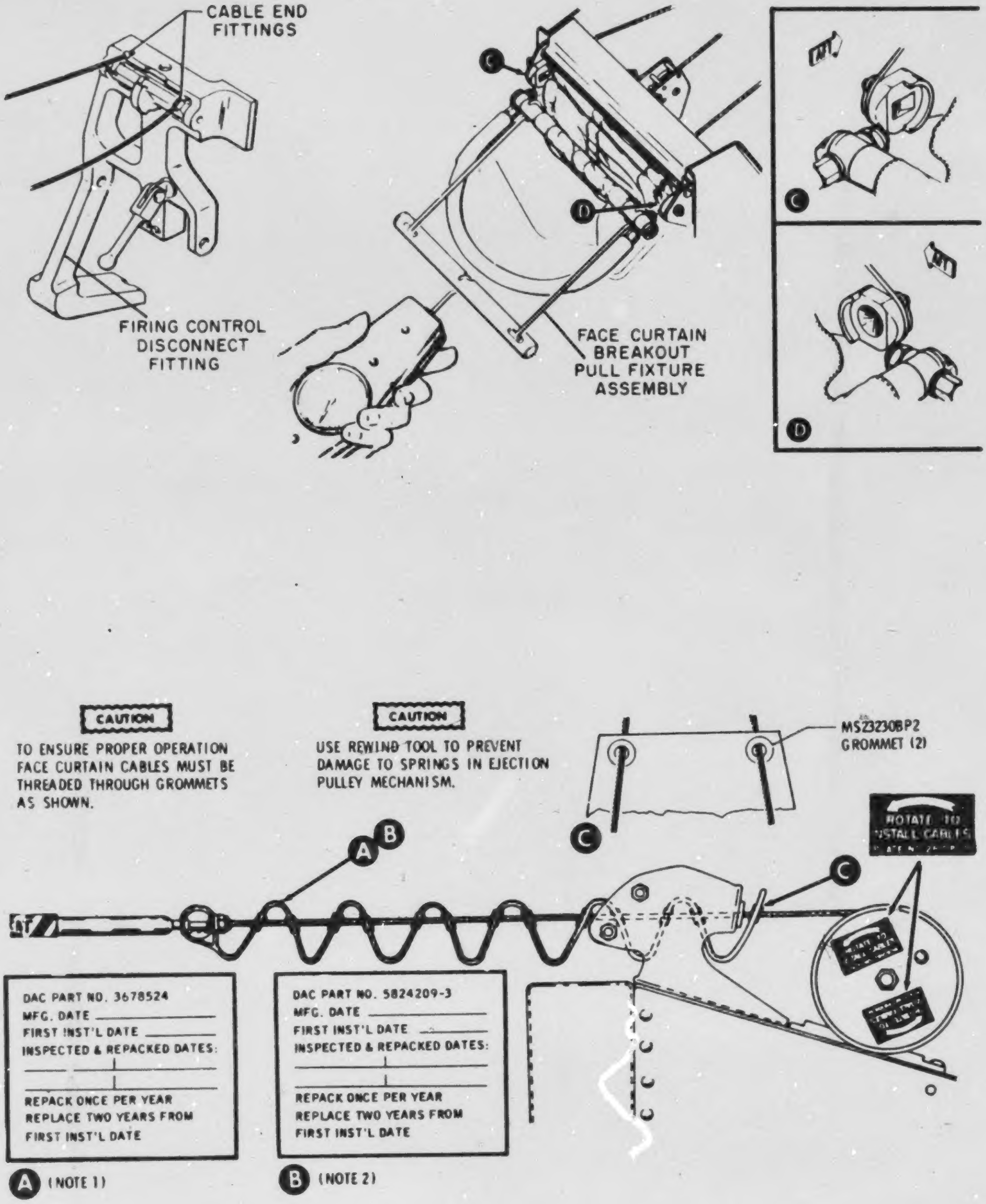
Fold the face curtain into accordion pleats and stow in its compartment aft of the control handle. Compress the firing control handle crossbar manually and snap into face curtain detent pivots. Place the ejection control safety handle in the full up position and secure the firing mechanism cover to the seat structure with its screws and washers.

SECONDARY EJECTION CONTROL HANDLE ASSEMBLY MAINTENANCE.—Maintenance of the secondary ejection control handle assembly consists of removal, parts replacement, installation, and operational check.

Since the secondary ejection control handle actuates essentially the same components as the face curtain handle, all of the tests required in this operational check may be performed in conjunction with the face curtain assembly operational check.

As in the face curtain handle check, the preparations required are as follows:

Place the seat on a suitable workbench, and position the ejection control safety handle in the full down position.


CABLE END FITTINGS
FIRING CONTROL DISCONNECT FITTING
C
D
FACE CURTAIN BREAKOUT PULL FIXTURE ASSEMBLY
C
D
CAUTION
TO ENSURE PROPER OPERATION FACE CURTAIN CABLES MUST BE THREADED THROUGH GROMMETS AS SHOWN.
CAUTION
USE REWIND TOOL TO PREVENT DAMAGE TO SPRINGS IN EJECTION PULLEY MECHANISM.
MS23230BP2 GROMMET (2)
C
ROTATE TO INSTALL CABLES
A
B
C
DAC PART NO. 3678524
MFG. DATE
FIRST INST'L DATE
INSPECTED & REPACKED DATES:
REPACK ONCE PER YEAR
REPLACE TWO YEARS FROM FIRST INST'L DATE
A (NOTE 1)
DAC PART NO. 5824209-3
MFG. DATE
FIRST INST'L DATE
INSPECTED & REPACKED DATES:
REPACK ONCE PER YEAR
REPLACE TWO YEARS FROM FIRST INST'L DATE
B (NOTE 2)

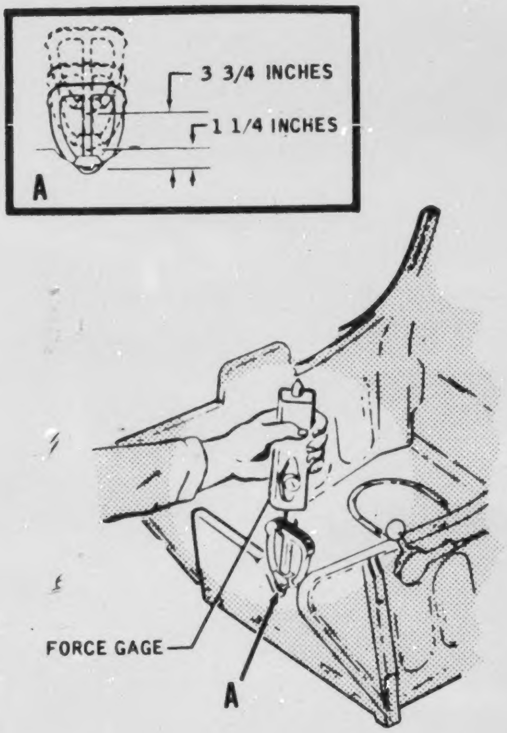
AM.677

Figure 8-57.—Face curtain detent disengagement check, face curtain assembly, and cable end fitting installation and disconnect.

Attach the force gage to the center of the secondary ejection control handle. Observe the gage and pull straight up to disengage the handle from its detent as illustrated in figure 8-58. Force required to disengage the handle from the detent position can be found in the appropriate MIM.

With the force gage still in place, increase tension on the control handle to 25 (±5) gagepounds and check to see that the handle does not extend less than 1/4 inch or more than 1 1/4 inches from the stowed position.

Next, place the ejection control safety handle in the full up position and pull the secondary control handle until the safety lockpin bottoms out in the socket. The secondary ejection handle should extend at least an additional 2 1/2 inches with a force of 25 (±5) gage-pounds applied to the handle.



AM.1222

Figure 8-58.—Secondary control handle disengagement and cable length check.

Retract the pin in the firing control disconnect assembly manually and remove the secondary firing cable. Continued pull on the secondary ejection handle will allow the handle and cable to disengage from the seat.

At the completion of this part of the operational check, the secondary ejection handle is reinstalled and the cable is connected. Make certain the firing control safety lockpin bottoms out in the socket when the secondary ejection handle is pulled. This completes the operational check of the secondary ejection control handle.

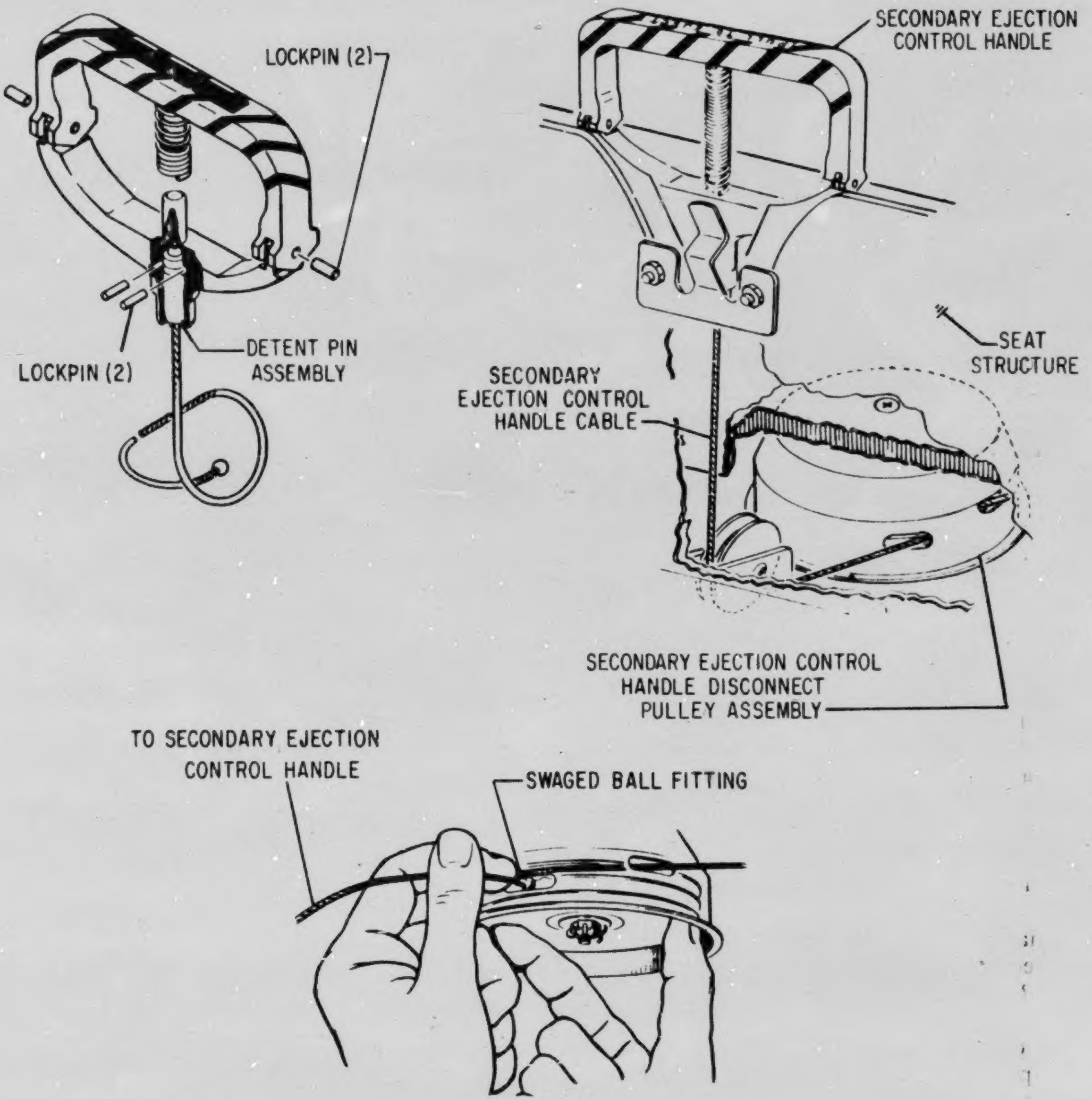
Secondary Ejection Control Handle Installation.—Prior to the installation of the secondary ejection control handle, the cable assembly is inspected for kinks, broken strands, corrosion, and condition of the end fitting. Any damage to this assembly is cause for replacement.

The handle assembly (fig. 8-59) is inspected for damage or distortion, correct installation of the cable lockpins and handle hinge pins, condition of the spring assembly, and that no binding of the handle hinge action exists.

Make certain that the ejection control safety handle is in the full up position, and insert the secondary ejection control handle and cable assembly through the handle recess hole in the center of the forward beam of the seat assembly. Make certain that the handle snaps into detent position.

Inspect the secondary control cable disconnect pulley housing for damage or distortion, insuring that it is undamaged and the pulley detents are free of cracks or burrs. The next step is to remove the secondary firing cable from the firing control disconnect assembly by manually retracting the pin in the disconnect housing, and rotating the disconnect pulley counterclockwise, viewed from the bottom, until the spring force is felt.

Next, rotate the pulley up to 90 degrees in either direction until the ball detent appears in the upper slot of the disconnect pulley housing. Pull the lower end of the coaxial cable out of the housing fitting, adjacent to the disconnect pulley, and insert the ball stop through the slot of the disconnect pulley housing and into the detent.


LOCKPIN (2)
LOCKPIN (2)
DETENT PIN ASSEMBLY
SECONDARY EJECTION CONTROL HANDLE
SEAT STRUCTURE
SECONDARY EJECTION CONTROL HANDLE CABLE
SECONDARY EJECTION CONTROL HANDLE DISCONNECT PULLEY ASSEMBLY
TO SECONDARY EJECTION CONTROL HANDLE
SWAGED BALL FITTING

AM.679

Figure 8-59.–Secondary ejection control handle installation.

Rotate the pulley counterclockwise approximately one turn and take up the coaxial cable until the ball end detent of the lower pulley groove appears in the lower slot of the disconnect pulley housing. Then insert the ball-stop of the secondary ejection handle into the lower pulley detent.

The next step is to release the pulley and pull on the upper end of the secondary firing cable to take up slack in the secondary ejection handle cable, and to connect the secondary firing cable to the firing control disconnect assembly at the top of the seat.

This completes the installation procedure for the secondary ejection control handle, and the ejection control safety handle is pulled to the full down position to safety the ejection control handles.

SEPARATOR ROCKET MAINTENANCE.—Maintenance of the separator rocket consists of removal and installation (fig. 8-60).

Removal. Make certain aircraft ground handling safety equipment is installed and that the ejection control safety handle is in the down position. Remove in accordance with instructions in the applicable MIM.

After removal, install the protective cap on the rocket and install the plug in the hose.

Installation. If the removed rocket is to be replaced, be sure and inspect the shipping container of the new rocket for evidence of damage. If it appears to have been damaged, do not uncrate the rocket. Return container and rocket to loading activity. Finding the container undamaged, inspect the rocket for damage. If damaged, return to supply.

WARNING: Any separator rocket unit that has been dropped must be so marked and returned to the loading activity. Do not perform any repairs or attempt to disassemble any part of the separator rocket.

Make certain service life of new separator rocket is entered in the aircraft logbook. Entry should show type of device, installation date, lot number and expiration date.

Connect tube assembly to separator rocket end fitting and tighten B-nut to 100 inch-pounds of torque and torque stripe fitting. Position rocket in position and install washers and screws.

TESTING HARNESS RELEASE HANDLE.—Maintenance of the harness release handle consists of lubrication, removal, installation, and testing.

CAUTION: The harness release handle is provided with dry film lubrication upon fabrication. Do not apply additional lubrication unless more than 40 pounds of force is required to pull the harness release handle. If excessive force is still required to pull the handle, remove and replace the assembly.

In preparation for testing the harness release handle, the ejection seat must be removed from the aircraft. Slowly pull the harness release handle on the seat until the manual detent pin engages the harness release actuator piston. The harness release handle should have a minimum overtravel of 1/8 inch from manual detent position.

Attach the force gage (0 to 100 pounds) to the harness release handle and pull on the handle. The force required to release the handle must not exceed that specified in the appropriate MIM.

Pull the harness release handle until overtravel from the manual detent position is taken up. With this checked, restow the release handle in the holder.

The next step in the test is to insure that the lap belt retaining pins and the shoulder harness pin are completely withdrawn. Then manually retract the piston until the clevis at the lower end of the piston strikes the firing control disconnect actuator arm, and the piston detents in the fired position. Figure 8-61 shows the harness release system testing.

With the piston locked in the fired position and extended against the locks, the pin in the firing control disconnect housing should be retracted below the ball stop hole in the housing to allow the catapult firing cable to withdraw free of the disconnect housing. Continue to retract the piston until the piston bottoms against the stop washer at the lower end of the actuator housing. Overall travel of the piston head should be 3/32 (±1/16) inch.

Reseat the harness release mechanism by pulling the manual detent pin protruding through the right side of the seat and reconnect the catapult firing control cable to the disconnect housing assembly. Check the lap belt

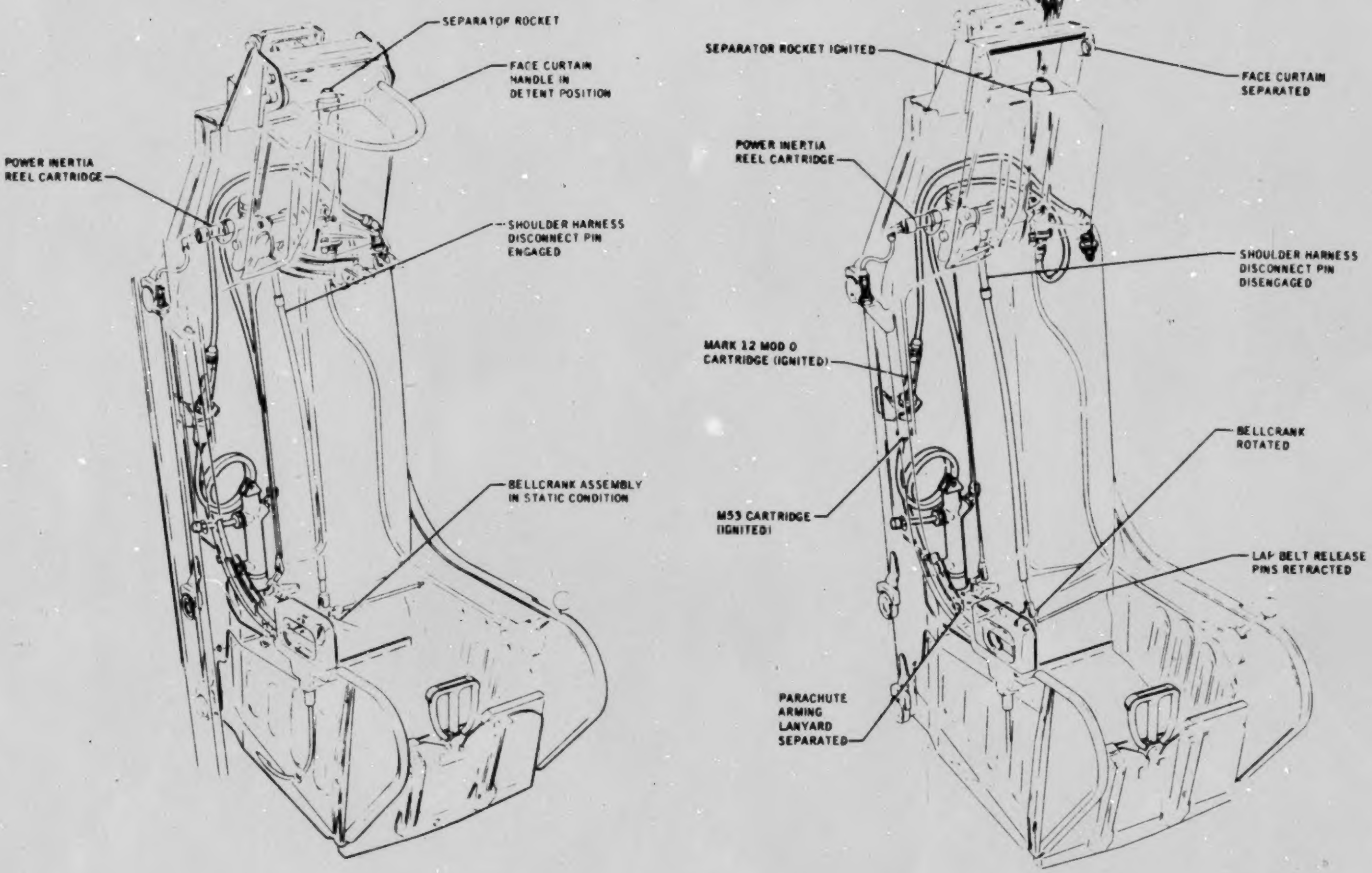
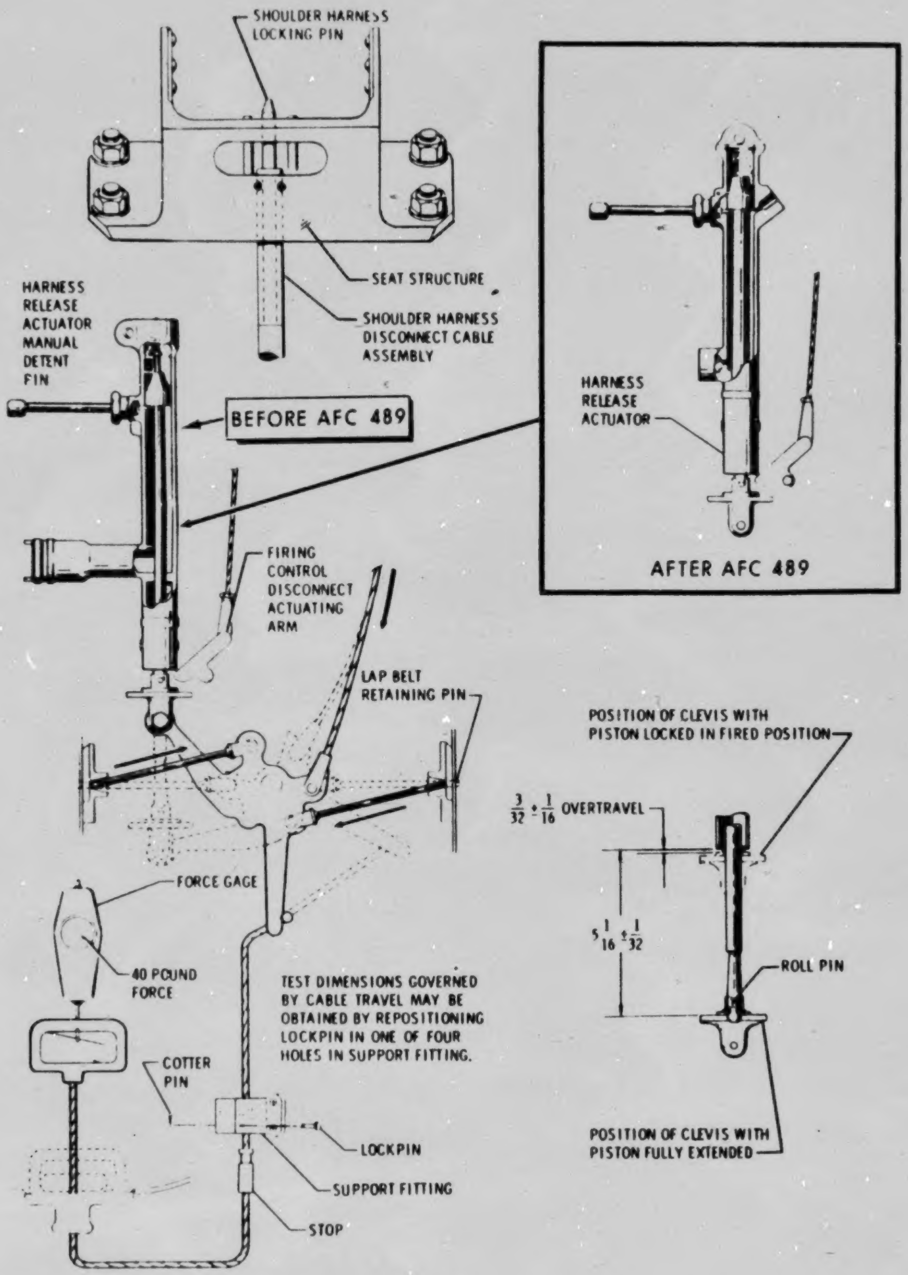

SEPARATOR ROCKET
FACE CURTAIN HANDLE IN DETENT POSITION
POWER INERTIA REEL CARTRIDGE
SHOULDER HARNESS DISCONNECT PIN ENGAGED
BELLCRANK ASSEMBLY IN STATIC CONDITION
SEPARATOR ROCKET IGNITED
FACE CURTAIN SEPARATED
POWER INERTIA REEL CARTRIDGE
SHOULDER HARNESS DISCONNECT PIN DISENGAGED
MARK 12 MOD 0 CARTRIDGE (IGNITED)
BELLCRANK ROTATED
M53 CARTRIDGE (IGNITED)
LAP BELT RELEASE PINS RETRACTED
PARACHUTE ARMING LANYARD SEPARATED
AM.1219

Figure 8-60.—Main-seat separator system.


SHOULDER HARNESS LOCKING PIN
SEAT STRUCTURE
SHOULDER HARNESS DISCONNECT CABLE ASSEMBLY
HARNESS RELEASE ACTUATOR MANUAL DETENT PIN
BEFORE AFC 489
HARNESS RELEASE ACTUATOR
AFTER AFC 489
FIRING CONTROL DISCONNECT ACTUATING ARM
LAP BELT RETAINING PIN
POSITION OF CLEVIS WITH PISTON LOCKED IN FIRED POSITION
$\frac{3}{32} \pm \frac{1}{16}$ OVERTRAVEL
$5\frac{1}{16} \pm \frac{1}{32}$
ROLL PIN
FORCE GAGE
40 POUND FORCE
TEST DIMENSIONS GOVERNED BY CABLE TRAVEL MAY BE OBTAINED BY REPOSITIONING LOCKPIN IN ONE OF FOUR HOLES IN SUPPORT FITTING.
COTTER PIN
LOCKPIN
SUPPORT FITTING
STOP
POSITION OF CLEVIS WITH PISTON FULLY EXTENDED

AM.1220

Figure 8-61.—Harness release system testing.

and shoulder harness pin for a minimum of 1/16-inch protrusion, excluding the tapered ends.

HARNESS RELEASE ACTUATOR CARTRIDGE INSTALLATION.–Maintenance of the Mk 12 Mod 0 and M53 cartridge actuated initiators and flex hose assemblies consists of removal and installation. When removal of the initator is required, due to expiration of service life or detonation of the cartridge, the linkage is removed and the initiator is disposed of per BUWEPS INSTRUCTIONS 13510.1. For service life of the separation system Mk 12 MOD 0 and M53 cartridge actuated initiators, refer to NAVAIR 11-100-1.

WARNING: Do not perform any maintenance on the initiator or attempt to remove the cartridge. Do not open the initiator for any reason. Initiators must be replaced if dropped.

Make certain OUTLET port of Mk 12 Mod 0 initiator is installed in INLET port of M53 initiator. Flow arrow must point toward bottom of the seat.

Install packing (MS28778-4) on Mk 12 Mod 0 initiator and install outlet port to inlet port of Mk53. Tighten to 100 inch-pounds of torque and torque stripe. Figure 8-62 shows proper installation of Mk 12 Mod 0 initiator to Mk53 initiator.

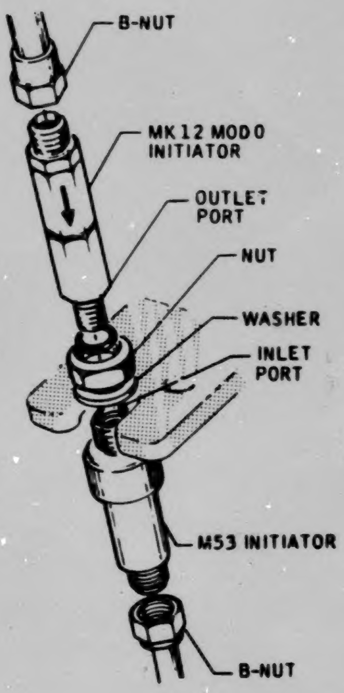


Figure 8-62.–Installation of Mk 12 Mod 0 initiator to Mk 53 initiator.

TESTING INERTIA REEL.–To check strap extensions and retraction, move the inertia reel manual control lever to the UNLOCK position. Pull both straps simultaneously. Straps should extend and retract freely into the reel.

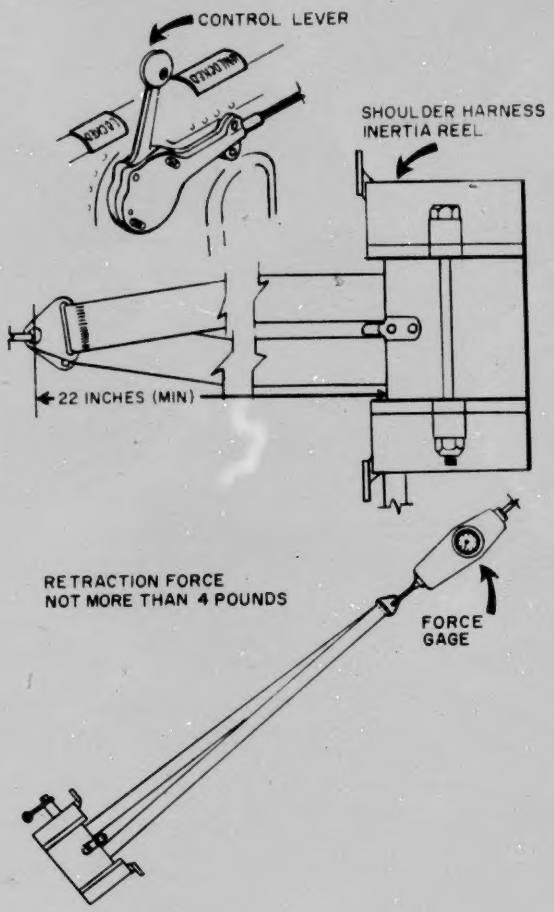
To check the snubbing action of the inertia reel on the straps, move the manual control lever to the LOCKED position. Pull the inertia reel straps. The straps should be locked, permitting not more than a 2-inch extension.

Maximum strap extension is checked by placing the manual control lever in the UNLOCKED position and fully extending the straps. They should extend 22 inches measured from the centerline of the hole in the strap end fittings to the face of the reel housing, at the point of attachment of the strap divider post.

The strap retraction force may be measured at this time, using the force spring scale. The retraction force of the inertia reel straps when fully extended should not exceed 4 pounds. Figure 8-63 shows the inertia reel check and testing procedures.

Place the manual control lever in the LOCKED position and allow the straps to ratchet back into the reel. The straps should then lock in the retracted position, permitting no more than a 2-inch extension out of the reel assembly. If the shoulder harness inertia reel does not check out during the testing procedures, adjust in accordance with the Maintenance Instructions Manual. If it does not function satisfactorily after adjustment, replace the assembly.

EJECTION SEAT STABILIZATION SYSTEM MAINTENANCE.–The maintenance of the ejection seat stabilization system consists of removal, inspection, repair, and installation. For


CONTROL LEVER
UNLOCKED
LOCKED
SHOULDER HARNESS INERTIA REEL
22 INCHES (MIN)
RETRACTION FORCE NOT MORE THAN 4 POUNDS
FORCE GAGE

AM.682

Figure 8-63.—Inertia reel check and test procedures.

removal of the ejection seat stabilization system, the first step is to insure that all ground handling and safety equipment is installed on the seat and cockpit area before removal is initiated.

Remove the survival equipment and remove the ejection seat from the aircraft, placing it in a clean work area.

Figure 8-64 is an illustration of the components and their location of the ejection seat stabilization system.

Remove the nuts, washers, and screws securing the brake assembly, clips to the seat panel assembly, bracket to the seat shelf, lanyard guides to the forward beam of the seat, and brackets and spacers to the forward beam of the seat. The next step is to cut and remove the nylon cord securing the A-frame to the clips and remove the ejection seat stabilization system from the ejection seat.

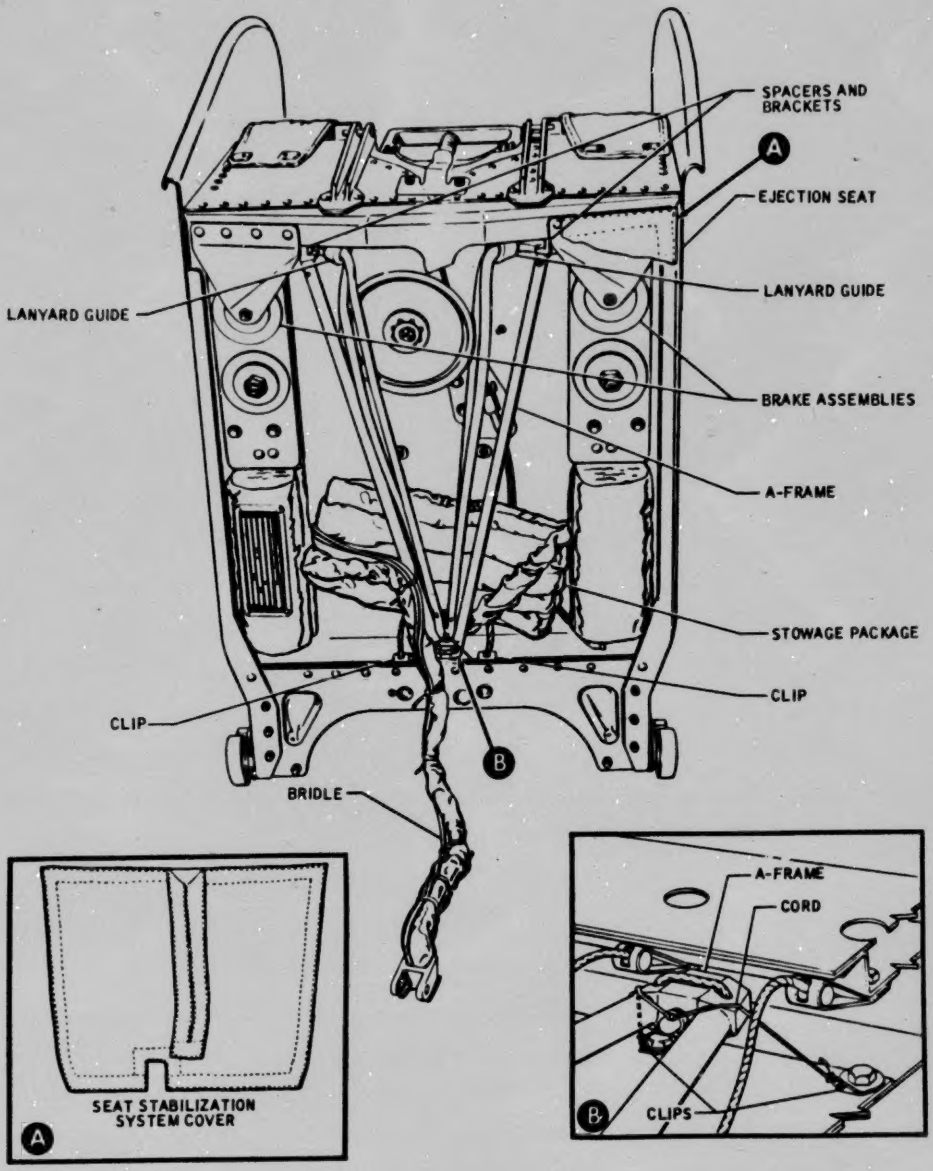
Reinstall the ejection seat stabilization system by positioning it back in the ejection seat and securing it with the nuts, washers, and screws. Secure the A-frame to the clips using Mil-C-5040 nylon cord. Make sure that the A-frame is not more than 1/8 inch below the seat bottom. Insure that the lanyard is routed directly from the stowage package and not through the A-frame.

Inspect and make certain that all tools and equipment have been removed, and that the seat is clean and free of dirt and all foreign matter. After installation of the seat, install the survival equipment.

NORTH AMERICAN HS-1 EJECTION SEAT

The North American ejection seats in the past have been mistakenly referred to as TALCO. The name TALCO is the rocket used in the seat system and not the correct designation of the seat. When referring to this seat, the proper noun name would be, for example, North American HS-1. At present there are five different designations of seats—LW-1, LW-2, LW-3, LS-1, and HS-1. The letters in the designation indicate the type of seat; for example, LW is a lightweight seat, LS is a low-speed seat, and HS is a high-speed seat. The Arabic numeral, following the letters, indicates the model of that seat as modified for individual aircraft requirements.

The HS-1 seat is presently used in the RA-5C aircraft and has been selected as a representative type to be discussed in this training manual. This seat is another rocket assisted personnel ejection escape system used for ejection at all altitudes from ground level, at 90 percent of takeoff speed, on up to maximum airspeed and altitude capabilities of the aircraft. The latest modification has given the seat zero/zero capability.


SPACERS AND BRACKETS
A
EJECTION SEAT
LANYARD GUIDE
LANYARD GUIDE
BRAKE ASSEMBLIES
A-FRAME
STOWAGE PACKAGE
CLIP
CLIP
B
BRIDLE
SEAT STABILIZATION SYSTEM COVER
A
A-FRAME
CORD
CLIPS
B

AM.683

Figure 8-64.—Ejection seat stabilization system—maintenance.

Description

The ejection seat system consists of a seat bucket and carriage assembly, an electrical seat adjustment system, a ballistic system, a seat propulsion system, a seat stabilizing chute system incorporating a stabilizing chute separation system, a body-position and retention system, a seat-man separation system, an integrated harness system, and a survival kit which includes the emergency oxygen supply system and composite disconnect. These units are operated and controlled by a system of actuators, thrusters, initiators, valves, lanyards, and related plumbing.

Pulling either the face curtain handle or actuating the ejection initiating system handgrips will result in the following automatic sequence: ejecting the canopy, positioning the crewman's arms, legs, and shoulders; bottoming the seat bucket to the lowest position; and firing the catapult rocket which propels the seat-man combination to a safe recovery.

EJECTION SEAT ASSEMBLY.–The ejection seat assembly, illustrated in figure 8-65, is an aircraft personnel seat containing safety and jettisonable features for the occupant.

The seat is supported in the aircraft by two fixed rails mounted to the canted bulkhead behind the seat. The seat's two pairs of rollers and two slide blocks position the seat carriage on the fixed rails. These two components, fixed rails and rollers, provide alignment of the seat during ejection and aid in installation and removal during maintenance. The lower pair of rollers contains a piston which is actuated by gas pressure in order to release the lower drogue chute risers and attach fittings and permits release of the upper riser retaining links.

The seat bucket, a portion of the seat assembly, incorporates four rollers which ride in two tracks in the carriage assembly. (See fig. 8-66). During seat adjustment operation, the seat bucket is moved up and down in the carriage. The flexible lines routed from the carriage to the seat bucket have sufficient slack to allow movement of the bucket. By moving the bucket in the carriage during seat adjustment, each pilot can adjust the seat to meet his own physical characteristics while still keeping his head against the fixed headrest which is mounted on top of the seat carriage. This keeps his eyes within the optimum line of sight through the windshield.

Each cockpit in the RA-5C aircraft incorporates a completely separate but identical seat adjustment system. This system consists of a dual screwjack-type actuator, a seat adjustment switch with three positions–UP, OFF, and DOWN–and related wiring and circuit breaker. Unlike most conventional seat actuators, the one on the RA-5C seat includes seat crossmember supports and the catapult-rocket trunnion fittings as part of the basic assembly. (See fig. 8-66).

The dual screwjacks of the actuator extend downward and connect to the two seat bottoming actuators. The bottoming actuators are mounted to the back side of the seat bucket and are internally locked at all times other than ejection. During normal operation, the actuator merely serves as securing points for the screwjacks to move the bucket up and down in the carriage for seat adjustment. The seat adjustment actuator provides approximately 3 inches of upward travel and 2 ¼ inches of downward travel.

Located on the bottom of the seat, as illustrated in figure 8-66, is the ejection seat lift plate. This lift plate provides additional aerodynamic lift during ejection. Operation of the plate is completely mechanical and is not connected to any other system on the seat. The lift plate is hinged at the forward bottom edge of the seat carriage and attached to the rear edge by two folding braces which incorporate spring-loaded locks. With the seat in the aircraft, the plate and braces remain in the folded, unlocked position. During initial travel of the seat up the rails, the lift plate swings fully down to approximately 30 degrees. With the plate fully down, the braces are unfolded and locked in this position as shown in figure 8-66.

BODY-POSITIONING AND RETENTION SYSTEM.–The body-positioning and retention system is designed to position and retain the occupant in the ejection seat during ejection. The system consists of a seat-bottoming mechanism and two seat-bottoming actuators, a knee-elevating and foot-retracting mechanism and two knee-elevating actuators, an automatic

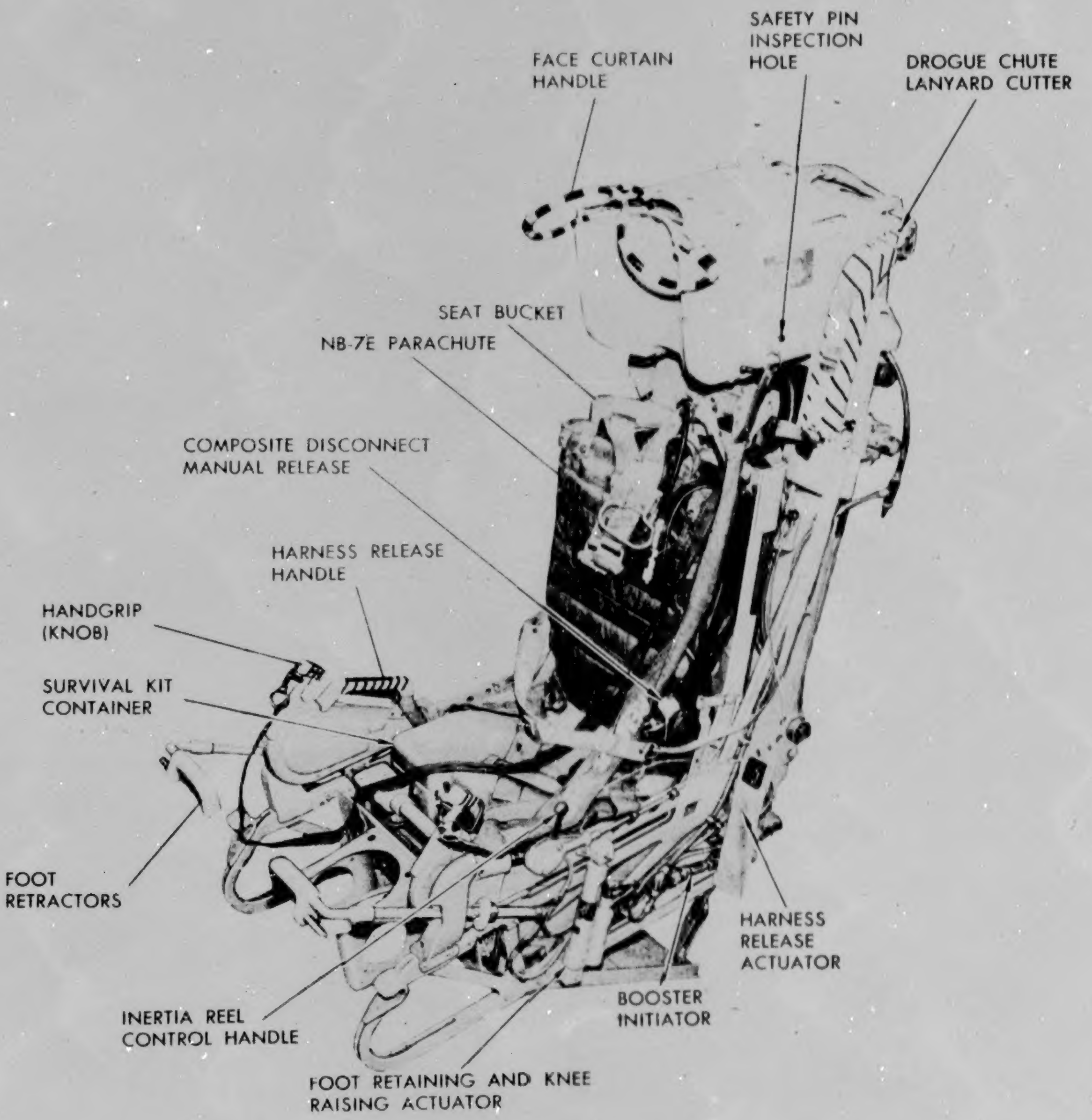
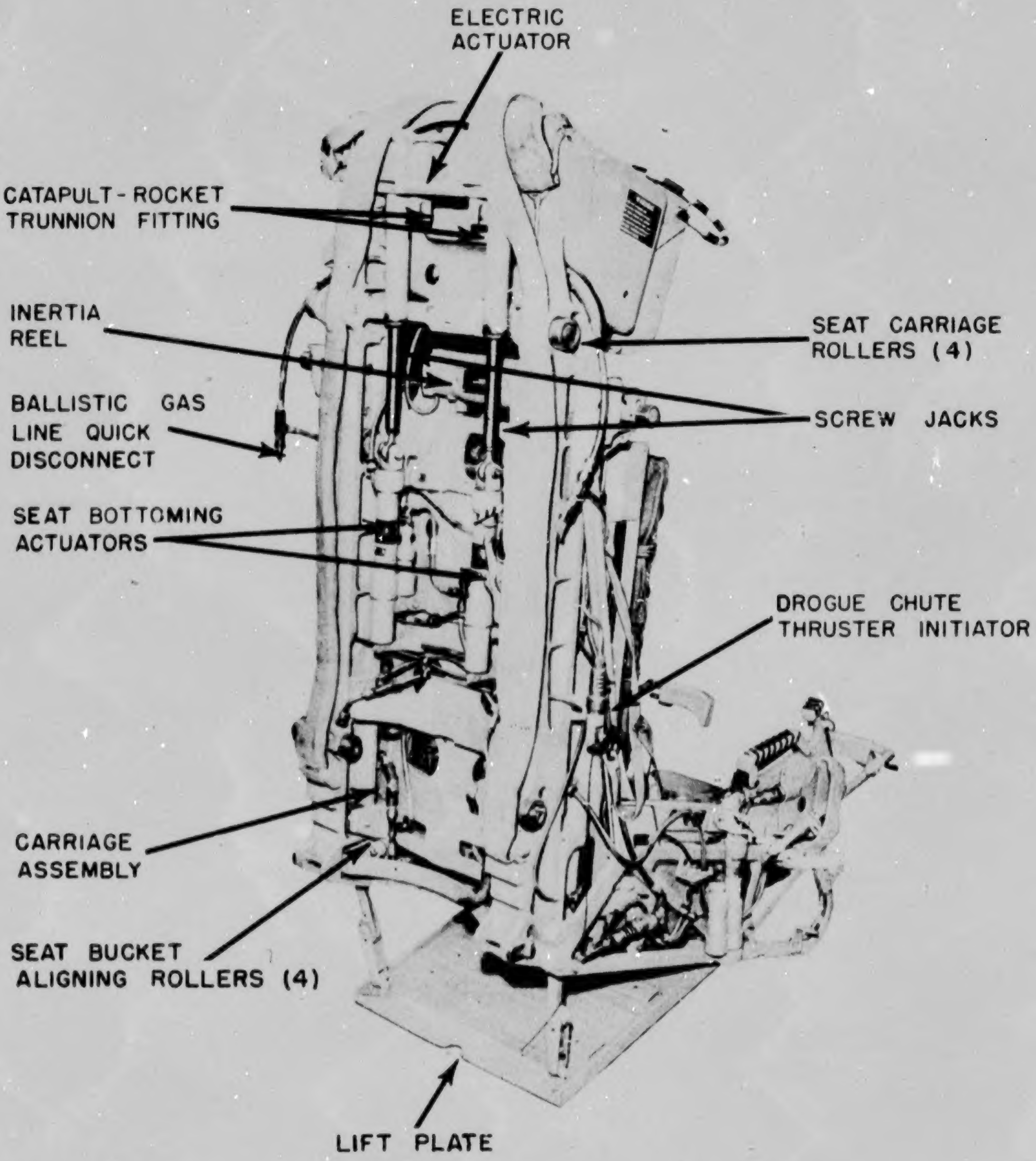

SAFETY PIN INSPECTION HOLE
FACE CURTAIN HANDLE
DROGUE CHUTE LANYARD CUTTER
SEAT BUCKET
NB-7E PARACHUTE
COMPOSITE DISCONNECT MANUAL RELEASE
HARNESS RELEASE HANDLE
HANDGRIP (KNOB)
SURVIVAL KIT CONTAINER
FOOT RETRACTORS
HARNESS RELEASE ACTUATOR
BOOSTER INITIATOR
INERTIA REEL CONTROL HANDLE
FOOT RETAINING AND KNEE RAISING ACTUATOR
AM.695

Figure 8-65.—North American HS-1 ejection seat.


ELECTRIC ACTUATOR
CATAPULT-ROCKET TRUNNION FITTING
INERTIA REEL
BALLISTIC GAS LINE QUICK DISCONNECT
SEAT BOTTOMING ACTUATORS
SEAT CARRIAGE ROLLERS (4)
SCREW JACKS
DROGUE CHUTE THRUSTER INITIATOR
CARRIAGE ASSEMBLY
SEAT BUCKET ALIGNING ROLLERS (4)
LIFT PLATE

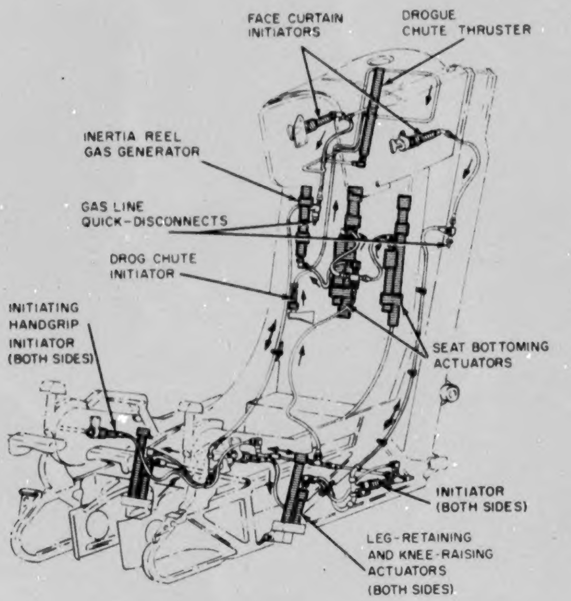
AM.684

Figure 8-66.—HS-1 Ejection seat components.

locking gas-operated harness takeup inertia reel, and an arm retention system.

The leg-retaining and knee-raising actuators are initiated by propellent gas from the M53 initiators. (See fig. 8-67.) The shoulder harness takeup and inertia reel gas generator, the seat-bottoming actuators and the arm retention cable takeup reel are also initiated by M53 initiators. These initiators are activated by propellent gas from either the face curtain or the initiating handgrip initiators. When the system is actuated, the seat bucket is positioned fully down in the carriage, the seat occupant's knees are raised, his feet are retracted and restrained in wells in the front edge of the seat, his shoulders are pulled back and locked against the back of the seat bucket and his arms are retarded and restrained against his chest.

Seat-Bottoming Mechanism.—The seat-bottoming mechanism is located on the back side of the seat bucket, which includes two seat-bottoming actuators. Each actuator has two pistons—a lower release piston and an upper actuating piston. The release pistons are connected to an interconnect shaft, and the actuating pistons are connected to the jackscrews of the seat adjustment actuator.


FACE CURTAIN INITIATORS
DROGUE CHUTE THRUSTER
INERTIA REEL GAS GENERATOR
GAS LINE QUICK-DISCONNECTS
DROG CHUTE INITIATOR
INITIATING HANDGRIP INITIATOR (BOTH SIDES)
SEAT BOTTOMING ACTUATORS
INITIATOR (BOTH SIDES)
LEG-RETAINING AND KNEE-RAISING ACTUATORS (BOTH SIDES)

AM.685

Figure 8-67.—HS-1 ejection components and lines.

During normal seat adjustment operation, the actuators merely serve as securing points for the seat actuator jackscrews to move the seat bucket through its normal travel as previously explained. When the actuators are initiated during ejection, the release pistons extend downward and unlock the internal locking mechanism within the actuators as shown in figure 8-68. Pressure from the fired actuator cartridges forces the actuator housings to slide downward on their actuating pistons. The actuating pistons remain stationary since they are secured to the seat actuator jackscrews, which, in turn, are secured to the seat carriage. Since the actuator housings are mounted on the seat bucket, the bucket accompanies the downward movement of the actuators to the bottomed position. The interconnecting shaft is included as a safety feature in the event one of the actuators should fail to initiate.

Knee-Elevating and Foot-Retracting Mechanism.—The knee-elevating and foot-retracting mechanism raises the occupant's knees to the proper ejection position and causes his feet to be drawn against the front of the seat bucket. This mechanism consists of a knee-raising frame on each side of the seat.

The knee-elevating and foot-retracting mechanism, illustrated in figure 8-69, consists of a knee-raising frame on each side of the seat, two knee-raising actuators, and two mechanically actuated foot-retractors. The two knee-raising frames are interconnected by a knockout bar running across the front edge of the seat. Two pads are mounted on the bar and serve as a leg rest for the seat occupant during normal use.

During seat-man separation, the knockout knee bar will release and roll out of the mounts at each end of the bar when forward pressure is exerted on it. The knee-raising actuators are anchored to the carriage on each side of the seat with their actuating rods connected to the knee-raising frames. When the actuators are initiated, the piston rods extend and pivot the knee-raising frames upward. When the frames are fully up, two spring-loaded locks engage and lock the frames in position. During the upward

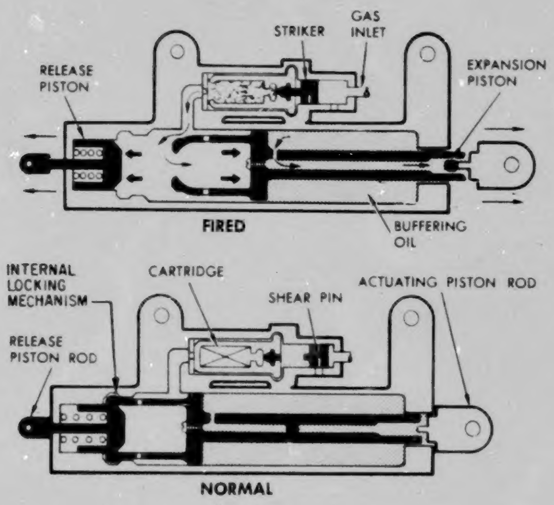


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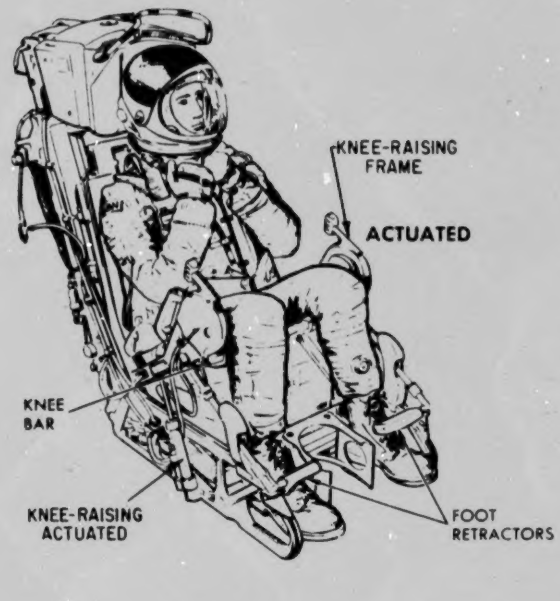
Figure 8-68.–Seat-bottoming actuator.



AM.687

Figure 8-69.–Knee-elevation and foot retracting mechanism.

movement, the knee-raising frames lift the occupant's knees, causing his legs and feet to swing back into wells located in the front edge of the seat. The padded foot-retractors are mechanically pivoted down and aft by the action of the knee-raising frames to a position in front of the wells. This prevents the occupant's feet from leaving the wells when the seat enters the airstream.

The foot retractors are made so that a portion of the hook tubing protrudes from the ends of the pads which are installed on the retractor hook. When the foot-retracting mechanism is actuated, this portion of the retractor hook engages a fitting attached to the carriage. This action retains the foot-retractors in position until the separation system is activated.

Knee-Elevating Actuators.–Each knee-elevating actuator, located on each side, includes a cartridge, a gas actuated initiating mechanism, an actuating piston and rod, a housing, and buffering oil. In its normal noninitiated condition, the piston rod is secured to the actuator housing by a shear pin. (See fig. 8-70.) This is intended to prevent any manual actuation of the actuator, during maintenance, which could disrupt the buffering feature of the piston.

When the actuator is initiated, expanding gases from the actuator cartridge force the actuating rod to break the shear pin and extend, raising the knee elevator frames. The buffering oil in the piston end of the actuator housing displaces at a controlled rate through an orifice in the piston, preventing rapid extension of the piston.

Harness Takeup Inertia Reel and Gas Generator.–The harness takeup inertia reel, located on the back side of the seat carriage below the headrest, automatically prevents the seat occupant from having forward movement during longitudinal deceleration forces or violent maneuvers. (See fig. 8-66.) It also positions and retains the occupant firmly back in the seat during the pre-ejection operation.

The reel incorporates a manual locking device with a conventional control handle, an automatic inertia locking mechanism, a shoulder harness release device, and a cartridge-actuated positioning and locking mechanism. The harness takeup inertia reel strap is attached to the

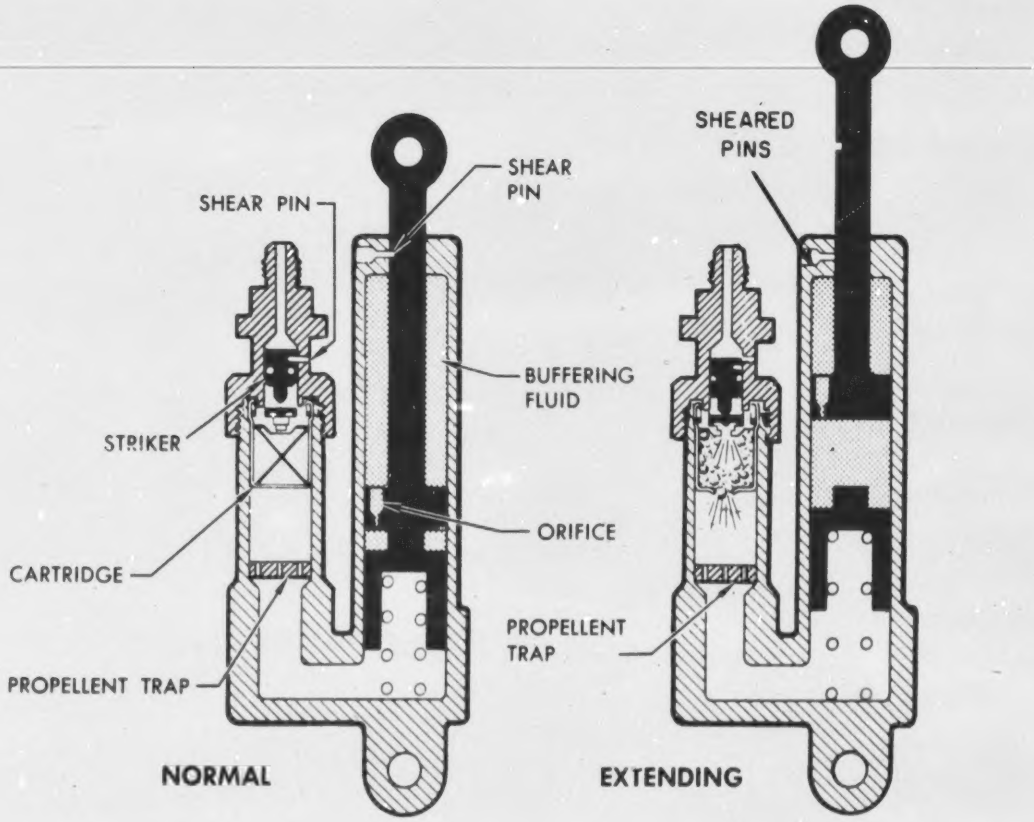
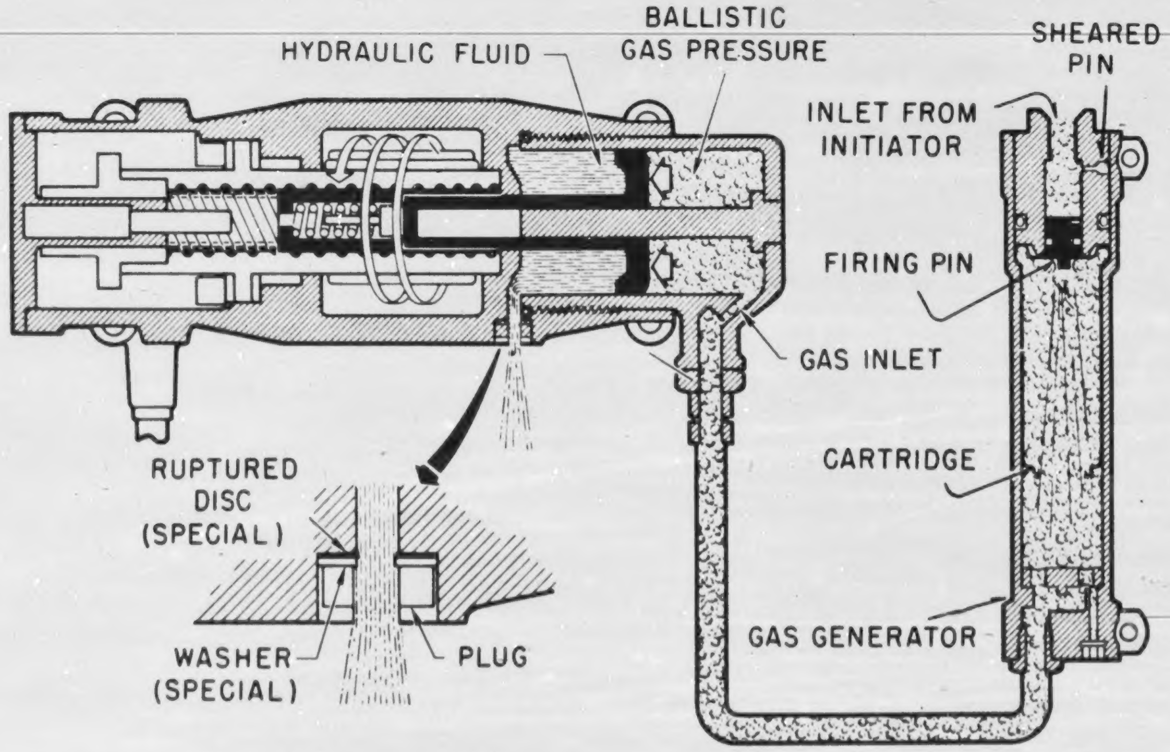


Figure 8-70.—Knee-elevating actuator.

integrated harness through a release device connected to the harness release mechanism.

With the reel control handle, located on the left-hand side of the seat, positioned to the LOCKED position, the harness takeup inertia reel strap is locked to prevent the seat occupant from bending forward. When the handle is moved to the UNLOCKED position, the strap is unlocked, allowing the seat occupant to lean forward. With the handle in the UNLOCKED position, the reel will automatically lock any time the aircraft encounters an excessive longitudinal deceleration. When the reel is locked in this manner, it will remain locked until the control handle is cycled—moved to the LOCKED position and then back to the UNLOCKED position.

During ejection, propellent gas pressure from two M53 initiators initiates a gas generator located below and outboard of the reel. (See fig. 8-71.) Expanding gases from the initiated gas generator cartridge enter the harness takeup inertia reel and exert a rotational motion to the reel strap takeup mechanism. This forcibly retracts the reel strap to position and lock the occupant against the seat. A buffering device is included in the reel to control the impact force between the seat occupant and the seat. This


BALLISTIC GAS PRESSURE
HYDRAULIC FLUID
SHEARED PIN
INLET FROM INITIATOR
FIRING PIN
GAS INLET
CARTRIDGE
RUPTURED DISC (SPECIAL)
GAS GENERATOR
WASHER (SPECIAL)
PLUG

AM.689

Figure 8-71.–Harness takeup inertia reel.

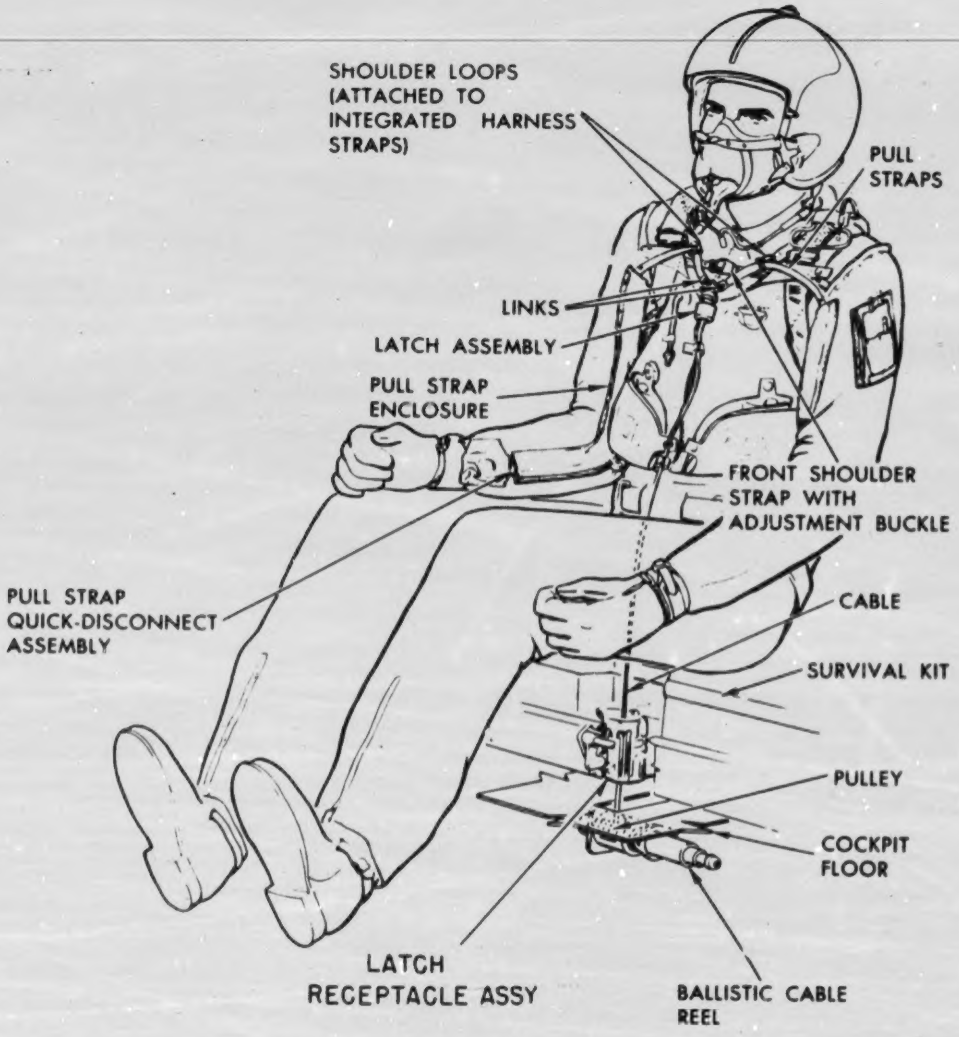
buffering action is accomplished by metering hydraulic fluid through a fixed orifice.

Arm Retention System.–To protect the crewman's arms, hands, and shoulder joints from injury due to wind blast, the arms are forcibly withdrawn from any extended position and restrained against the crewman's chest. The arms are held in this position until after seatman separation occurs.

The arm retention system consists of sleeve assemblies worn by the crewman, a cable and strap system, a strap locking and releasing mechanism located on the survival kit, a ballistic cable takeup reel, and two metal loops fastened to the integrated harness. The sleeve assembly units are connected together by straps worn across the chest and shoulders.

In addition, pull straps are attached to the wrists by means of a quick-disconnect sewn to the cuff of each sleeve assembly. (See fig. 8-72.) From the wrists, these straps are routed up the inside of the sleeves, through a loop on the shoulder, and terminate at a metal latch near the center of the chest. The straps are retained in the sleeves by cloth enclosures that allow them to pull out easily during seat ejection.

The metal latch, to which the pull straps are connected, is connected to a pull cable. This pull cable passes down the front of the crewman, between his legs, and through a receptacle on


SHOULDER LOOPS (ATTACHED TO INTEGRATED HARNESS STRAPS)
PULL STRAPS
LINKS
LATCH ASSEMBLY
PULL STRAP ENCLOSURE
FRONT SHOULDER STRAP WITH ADJUSTMENT BUCKLE
PULL STRAP QUICK-DISCONNECT ASSEMBLY
CABLE
SURVIVAL KIT
PULLEY
COCKPIT FLOOR
LATCH RECEPTACLE ASSY
BALLISTIC CABLE REEL

AM.690

Figure 8-72.—Arm retention system.

the front of the survival kit. From the receptacle, the cable is routed through the bottom of the seat and floor of the aircraft and around a pulley to the arm retention takeup reel.

When the face, curtain is pulled or the initiating handgrip squeezed, ballistic gas pressure initiates an M53 initiator. This gas pressure initiates the ballistic charge in the arm retention cable takeup reel. The gases within the takeup reel assembly force a piston to move which imparts a rotary motion on the takeup reel similar to the action within the inertia reel mechanism. This action winds the cable around the reel which causes the pull straps to pull out of the strap enclosure and position the crewman's arms against his chest.

As the cable retracts, the latch assembly enters the latch receptacle. When the latch bottoms in the receptacle, a steel washer, located in the bottom of the latch, is dislodged from the latch body. This action allows the retaining jaw, which holds the pull cable, to separate, thus allowing the cable to pull free of the latch and the arm retention system. When the cable pulls free, pressure on the arms causes the latch assembly to pull up in the receptacle until two spring-loaded cams which contact the body of the latch assembly restrict any movement in the receptacle.

During the seat-man separation sequence, inflation of the separation bladders forces the receptacle to slide up and out of the channel on the seat. As the receptacle rises in the channel, the cams are free to rotate and release the latch. The pulling force exerted by the arms will then cause the spring-loaded lockpin retract collar to contact two fiberglass catches in the receptacle.

The resulting pressure against the collar will overcome the spring tension holding the lockpin in the extended position, thus causing the lockpin to retract. Retraction of the lockpin, either automatically during the seat-man separation or manually during normal operation, will release the pull straps and allow unrestricted movement of the arms.

If an emergency arises where the crewman must leave the aircraft without hesitation, the cable may be pulled loose from the reel by exerting a 40- to 60-pound pulling force on the cable. If the cable is removed in this manner, the reel must be removed, disassembled, inspected for damage, and new shear pins, buffer fluid, and diaphragm installed.

SEAT PROPULSION SYSTEM.–The seat propulsion system consists of the catapult rocket and the necessary initiating systems to support it. When the initiation system is actuated, propellent gas pressure is routed to two ballistic-delay cartridges in the catapult rocket. The ballistic delays allow sufficient time for the canopies to jettison and seat- positioning systems to actuate before initiating the catapult cartridge. When the catapult cartridge initiates, it provides the necessary thrust to eject the seat clear of the aircraft, at which time the rocket tube ignites and propels the seat to a safe altitude for ground ejection while keeping the seat occupant within a safe "g" tolerance.

Catapult Rocket.–The catapult rocket includes the following major components: a catapult tube, a rocket tube, a locking device which secures the internal rocket tube to the catapult tube, attachments to the ejection seat, and attachments to the aircraft structure. (See fig. 8-73.) The catapult tube consists of a chamber, strikers, and a cartridge. The rocket tube consists of a chamber, an ignitor, propellant, and nozzle.

A trunnion fitting on the catapult tube attaches to the aircraft structure, and a trunnion fitting on the rocket tube attaches to the ejection seat. Unlike the catapult tube trunnion, the rocket tube trunnion is fixed and the diameter of the trunnion differs between the left-and right-hand sides to match the width of the trunnion forks on the headrest.

This eliminates the possibility of installing the catapult rocket 180 degrees out of position. This is necessary since the rocket propellent exhaust tube nozzle must be pointed aft.

In addition to the two trunnion fitting diameters, the rocket tube is marked near the top to indicate which side faces aft. A locking pin on the catapult tube fits into a cutout in the underside of the rocket tube flange to prevent the possibility of rotation between the two tubes.

The function of the catapult rocket is to remove the ejection seat and occupant from the aircraft and propel them to a height necessary for safe low-level parachute deployment. To eject from the aircraft, the occupant actuates either the face curtain or the initiating handgrips. This actuates two ballistic initiators, which detonate and discharge high-pressure gases to two ballistic-delay cartridges, which in turn, initiate and discharge high-pressure gases to the two strikers located in the lower portion of the catapult rocket catapult tube.

The firing pins actuate two primers and two ballistic-delay trains, which, in turn, initiate the catapult tube cartridge. Detonation of the catapult cartridge forces the rocket tube and ejection seat up the rails. The initial upward forces created on the rocket tube by the detonated cartridge automatically unlock the

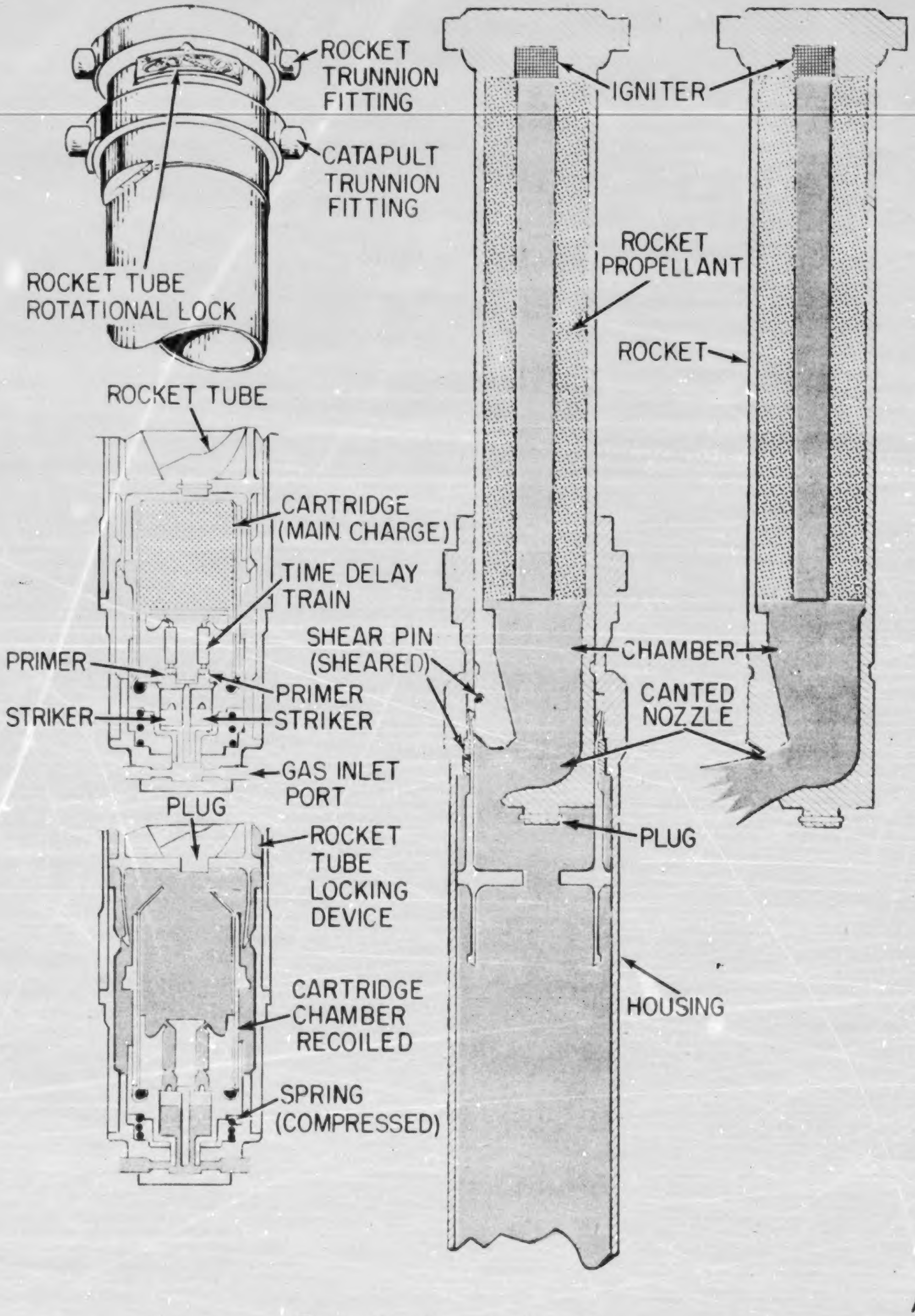

ROCKET TRUNNION FITTING
CATAPULT TRUNNION FITTING
ROCKET TUBE ROTATIONAL LOCK
ROCKET TUBE
CARTRIDGE (MAIN CHARGE)
TIME DELAY TRAIN
PRIMER
PRIMER
STRIKER
STRIKER
GAS INLET PORT
PLUG
ROCKET TUBE LOCKING DEVICE
CARTRIDGE CHAMBER RECOILED
SPRING (COMPRESSED)
IGNITER
ROCKET PROPELLANT
ROCKET
SHEAR PIN (SHEARED)
CHAMBER
CANTED NOZZLE
PLUG
HOUSING
AM.691

Figure 8-73.—HS-1 catapult rocket.

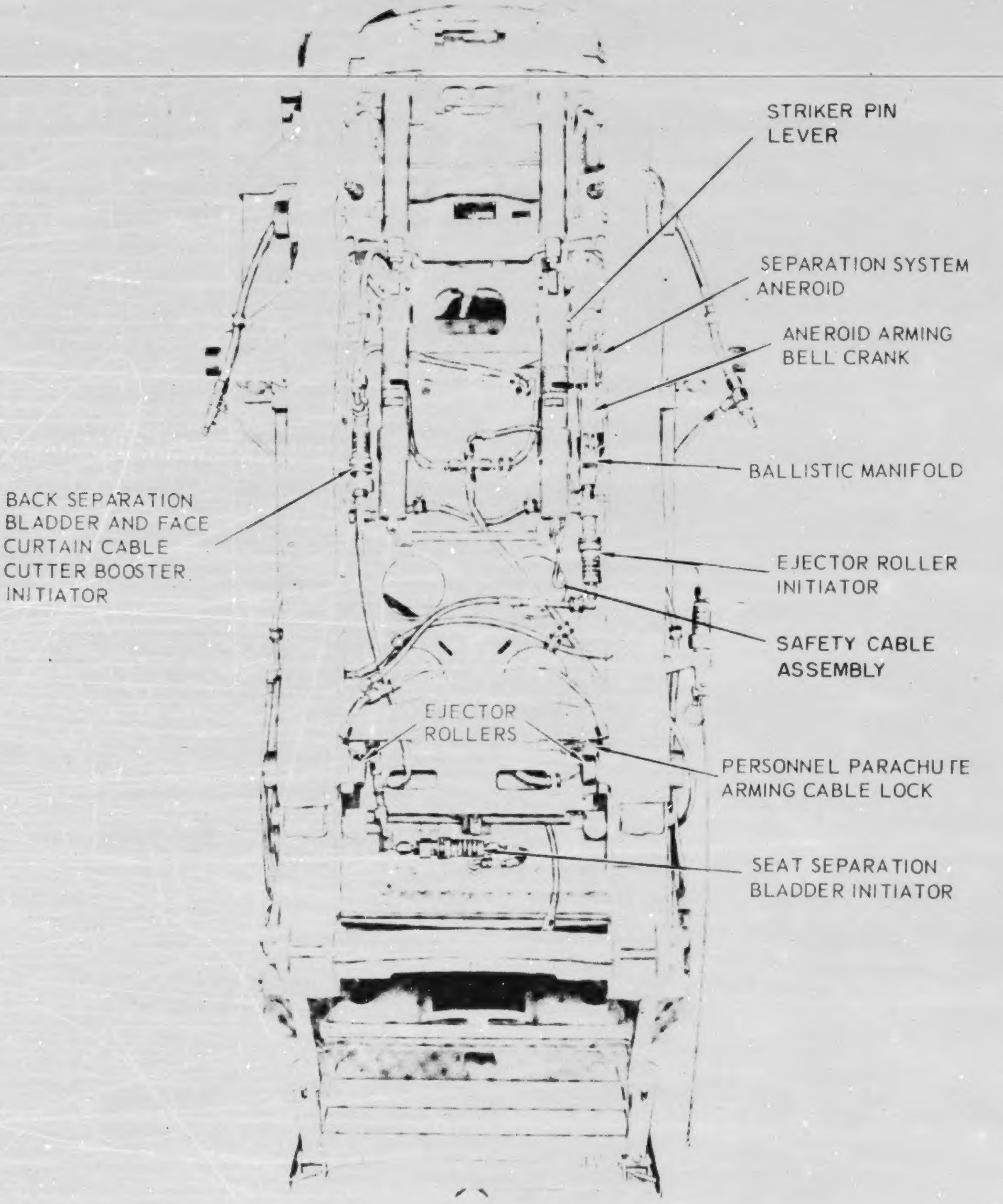
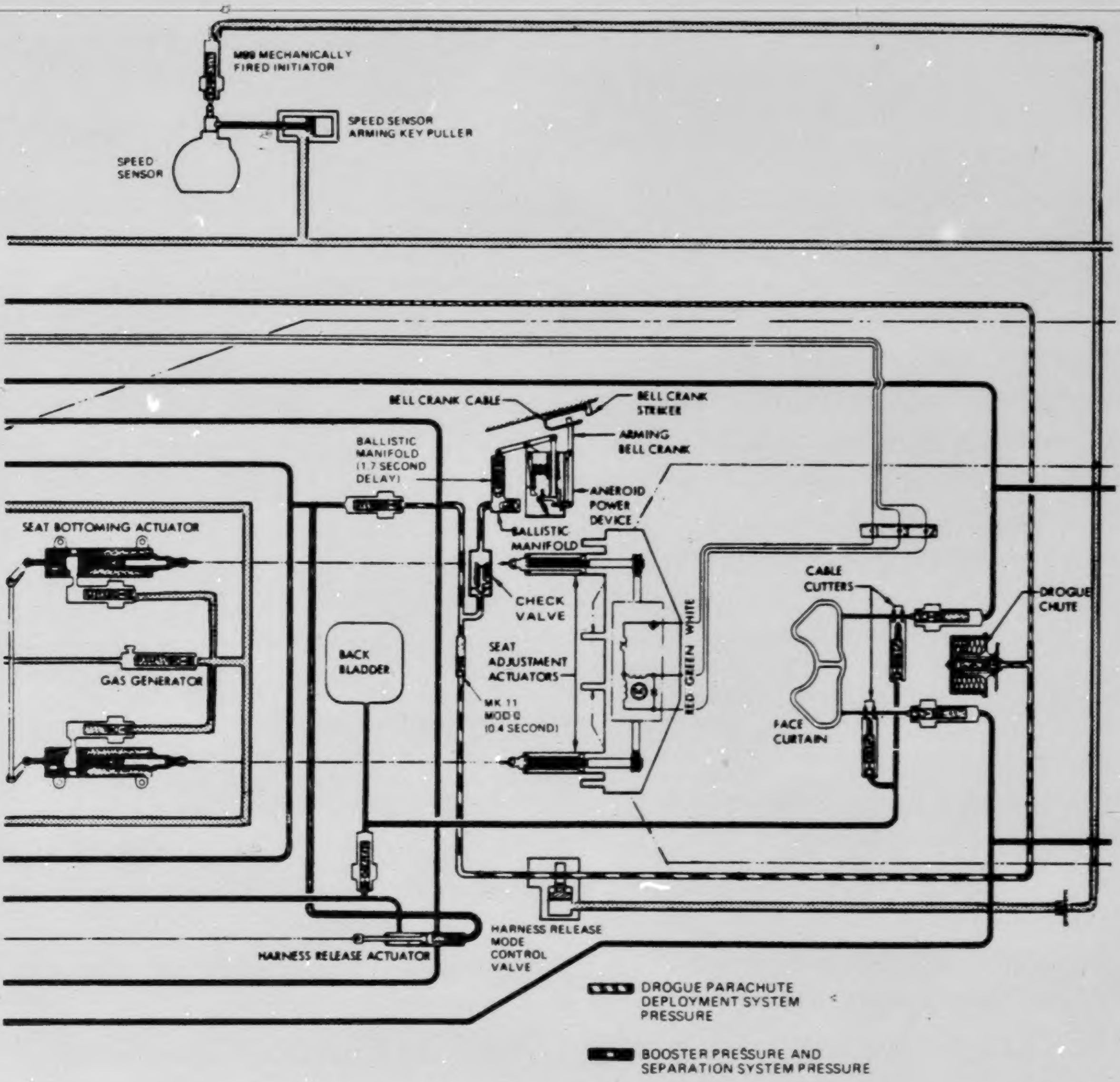
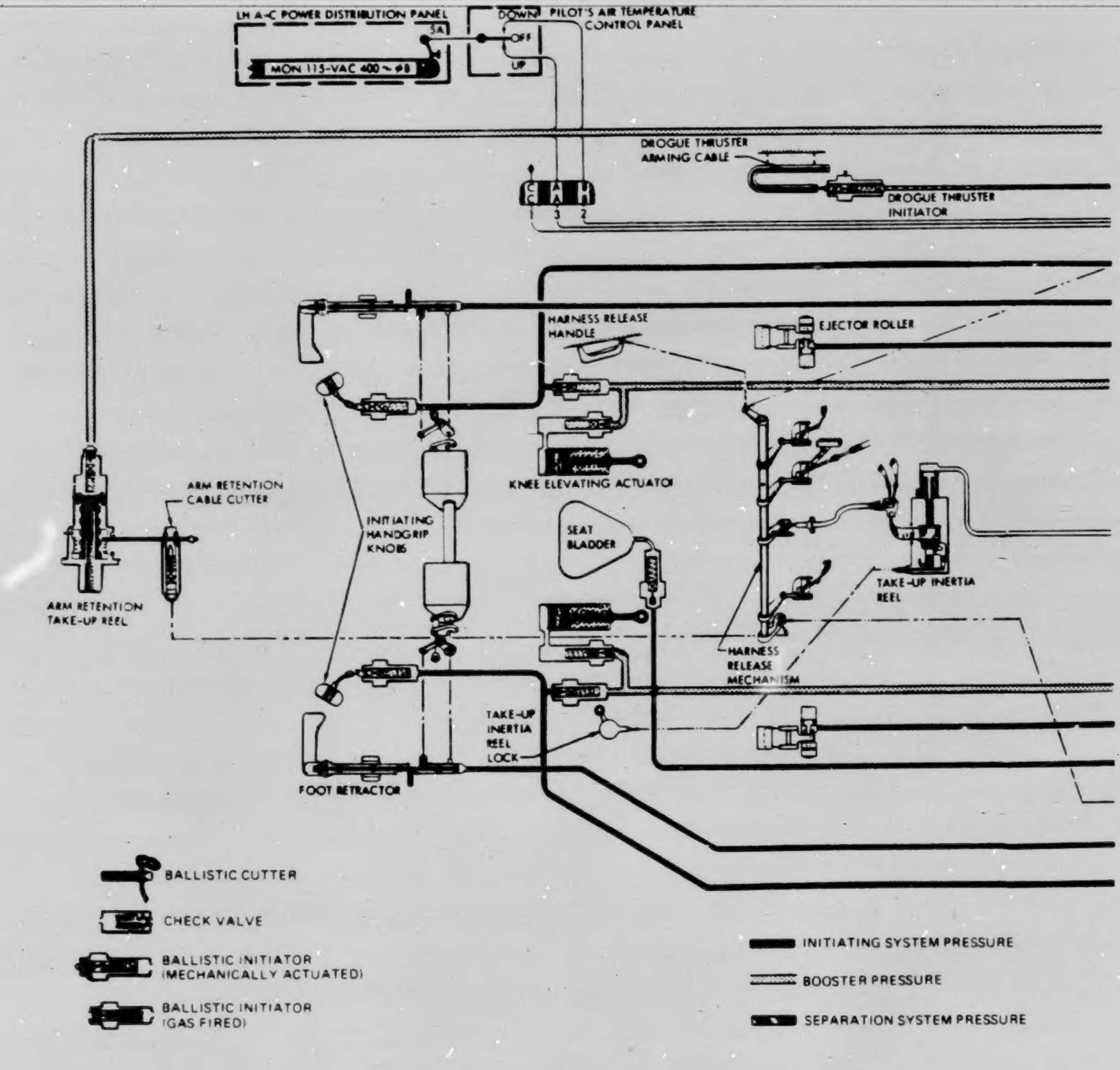

STRIKER PIN LEVER
SEPARATION SYSTEM ANEROID
ANEROID ARMING BELL CRANK
BALLISTIC MANIFOLD
BACK SEPARATION BLADDER AND FACE CURTAIN CABLE CUTTER BOOSTER INITIATOR
EJECTOR ROLLER INITIATOR
SAFETY CABLE ASSEMBLY
EJECTOR ROLLERS
PERSONNEL PARACHUTE ARMING CABLE LOCK
SEAT SEPARATION BLADDER INITIATOR
AM.692

Figure 8-74.—Release system components.


M99 MECHANICALLY FIRED INITIATOR
SPEED SENSOR ARMING KEY PULLER
SPEED SENSOR
BELL CRANK CABLE
BELL CRANK STRIKER
ARMING BELL CRANK
BALLISTIC MANIFOLD (1.7 SECOND DELAY)
ANEROID POWER DEVICE
SEAT BOTTOMING ACTUATOR
BALLISTIC MANIFOLD
CHECK VALVE
CABLE CUTTERS
DROGUE CHUTE
BACK BLADDER
GAS GENERATOR
SEAT ADJUSTMENT ACTUATORS
MK 11 MOD 0 (0.4 SECOND)
RED GREEN WHITE
FACE CURTAIN
HARNESS RELEASE ACTUATOR
HARNESS RELEASE MODE CONTROL VALVE
DROGUE PARACHUTE DEPLOYMENT SYSTEM PRESSURE
BOOSTER PRESSURE AND SEPARATION SYSTEM PRESSURE

AM.1226

Figure 8-75.—Schematic of the HS-1 release and separation system.


LH A-C POWER DISTRIBUTION PANEL
5A
MON 115-VAC 400 ~ φB
DOWN
OFF
UP
PILOT'S AIR TEMPERATURE CONTROL PANEL
DROGUE THRUSTER ARMING CABLE
DROGUE THRUSTER INITIATOR
C
C
A
H
1
3
2
HARNESS RELEASE HANDLE
EJECTOR ROLLER
KNEE ELEVATING ACTUATOR
ARM RETENTION CABLE CUTTER
INITIATING HANDGRIP KNOBS
SEAT BLADDER
TAKE-UP INERTIA REEL
ARM RETENTION TAKE-UP REEL
HARNESS RELEASE MECHANISM
TAKE-UP INERTIA REEL LOCK
FOOT RETRACTOR
BALLISTIC CUTTER
CHECK VALVE
BALLISTIC INITIATOR (MECHANICALLY ACTUATED)
BALLISTIC INITIATOR (GAS FIRED)
INITIATING SYSTEM PRESSURE
BOOSTER PRESSURE
SEPARATION SYSTEM PRESSURE

AM.1226

Figure 8-75.–Schematic of the HS-1 release and separation system–Continued.

catapult-to-rocket-tube locking device. As the seat nears the end of the rails, the hot gases from the catapult tube ignite the propellent igniter, which ignites the solid propellant in the rocket tube. At this time, the rocket tube separates from the catapult tube and continues to propel the ejection seat and occupant upward to the altitude necessary for ground-level parachute deployment.

NOTE: The RA-5C aft catapult-rocket initiating system does not contain the ballistic-delay cartridges, so the initiating gases are routed through check valves to the catapult tube.

SEAT STABILIZATION AND SEPARATION SYSTEM.–The stabilization and separation system stabilizes the seat and automatically separates the occupant from the ejection seat during the ejection sequence. It contains facilities for manual operation of the shoulder release mechanism if the automatic feature fails to function.

The stabilization and separation sequence may be divided into three specific phases-stabilization of the seat, release of the occupant, and forcible separation of the man from the seat. The seat is stabilized by an automatically ejected and deployed drogue parachute. Releasing the occupant after the seat has been stabilized is normally accomplished automatically by a ballistic-operated mechanism. After the occupant has been released, it is necessary to forcibly separate him from the seat to prevent possible inflight collision. This is done through the use of automatically inflated bladders which force the occupant free of the seat.

Stabilization of the Seat.–The ejection seat is stabilized through the use of a drogue parachute system. The drogue parachute consists of a drogue parachute mounted in the headrest, a drogue parachute thruster mounted in the center of the drogue parachute container and attached to the headrest, and a drogue parachute thruster initiator, located on the right-hand side of the ejection seat carriage. (See fig. 8-66.)

The thruster initiator is actuated by a cable which is mounted in a tube assembly on the side of the right-hand ejection seat rail. During ejection, the upward travel of the seat on the rails will pull the cable from the tube assembly until a swaged ball on the end of the cable bottoms against a threaded fitting on the top of the tube assembly. The cable then actuates the sear pin on the M99 thruster initiator.

The initiator gas pressure travels through a gas line to the drogue parachute thruster in the seat headrest, initiating the thruster cartridge and ejecting the drogue parachute container and drogue parachute. As the drogue parachute container leaves the seat, the drogue parachute risers pull the drogue parachute from the container. The drogue parachute's function is to decelerate and stabilize the seat in the airstream and pull open the NES 15A personnel parachute during seat-man separation.

Occupant Release.–The automatic release of the occupant from the ejection seat is controlled by an aneroid power device. This timing device is mounted on the back, right-hand side of the bucket, between the right seat-bottoming actuator and the right side of the seat structure. (See fig. 8-74.)

As the seat travels up the rail, a bellcrank connected to the separation system aneroid power device is tripped by a striker plate mounted on the seat bulkhead. If for some reason, the striker plate fails to trip the bellcrank, it will be tripped by a safety cable installed between the bellcrank and striker pin. If the altitude at time of ejection is below 13,000 feet, the aneroid device will initiate a ballistic delay cartridge in the ballistic-manifold.

The aneroid power device plunger is attached by a bellcrank to the ballistic-delay cartridge sear pin. The sear pin is pulled from the ballistic manifold by the plunger after the aneroid mechanism is armed (below 13,000 feet). During high-altitude ejections, the aneroid power device blocks seat-man separation until the occupant has descended below approximately 13,000 feet.

When at this altitude, the aneroid power device plunger actuates the manifold initiating mechanism, thus initiating the ballistic-delay cartridge. Figure 8-75 is a schematic of the ejection seat release and separation system. This schematic illustrates the aneroid in the cocked position. At a 13,000-foot altitude, the ballistic manifold sear pin is pulled. This initiates the ballistic-delay cartridge in the manifold, which, in turn, routes gas pressure to both the ejector rollers and harness release actuator initiators.

Consequently, as the harness release actuator cartridge initiates, the gas pressure produced is routed through the lines to the two upper outlets to the foot retractors. This action removes the foot retractors, which fall free from the seat.

At the same time as the expanding gases push the piston downward, the fork fitting on the lower end of the piston strikes the lever on the end of the harness release mechanism torsion bar, causing the mechanism to release the harness. Then, as the piston reaches the extended position, it allows the gas pressure to flow through the third outlet to the separation bladder booster initiators. Gas from the back bladder booster initiator fills the bladder and actuates the ballistic face curtain cable cutter. Whenever the harness release mechanism is actuated, mechanical actuation of the arm retention cable cutter is accomplished by a spring-loaded mechanism through mechanical linkage.

Speed Sensor.—On aircraft having AFC 311 incorporated, an improved escape system (HS-1A) provides reduced time delays, increased catapult impulse, and an improved parachute assembly incorporating a ballistic spreading gun.

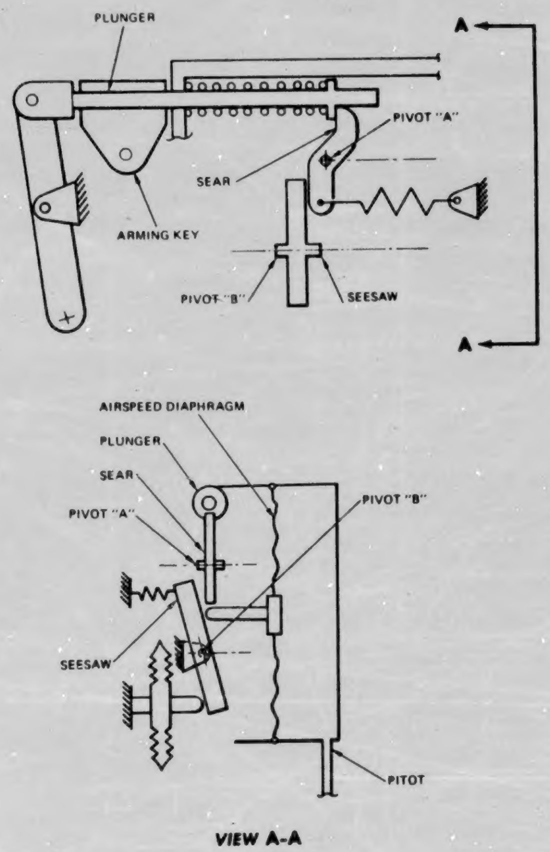
Except for a speed sensor and the spreading gun, the system is identical in operation at high speeds to the original (HS-1) system.

For reduced opening shock under high-speed, high-altitude conditions (above 10,000 feet and/or 200 knots), the speed sensor automatically selects a high mode time delay for harness release and separation bladder action after catapult rocket burnout. Total low mode sequence timing is reduced by 1 second.

Recovery capability in the high mode is the same as that for the unmodified (HS-1) system. Installation of an NES-15A parachute is required for the HS-1A system.

The speed sensor is mounted on a bulkhead at the right side and aft of each seat. A small inspection port is provided on each speed sensor. A red indication in this port is unacceptable, since this indicates speed sensor aneroid leakage.

Each sensor is composed of a spring-loaded plunger, a sear, a seesaw, an aneroid bellows, and an airspeed diaphragm. (See fig. 8-76.) The spring-loaded plunger is initially held in the retracted or cocked position by the arming key. The sear pivots about point "A" and is held in position by a light spring. In this position, the seesaw is free to move into the blocking or unblocking position. The seesaw pivots about point "B." It is also spring loaded toward the blocking position. The aneroid bellows and the airspeed diaphragm are mounted to work in parallel. Either can rotate the seesaw from the blocking to unblocking position. Blocking depends primarily upon position, not force; therefore, either one or the other will determine the blocking state. The seesaw rotates continuously with varying flight conditions. In the low mode regime, the seesaw is in a position



AM.1223

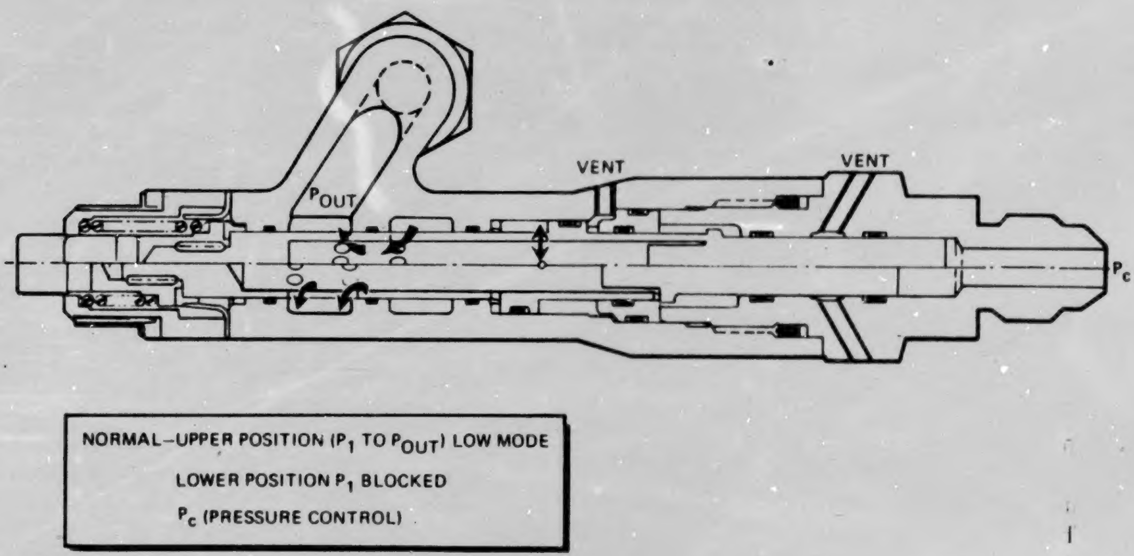
Figure 8-76.—Speed sensor.

which will block rotation of the sear which, in turn, will block extension of the plunger should the arming key be removed. In the high mode, the seesaw allows rotation of the sear, thus if the arming key is removed, the plunger pushes the sear aside and moves to the extend position.

Mode Control (Harness Release).–The mode control valve (fig. 8-77) is mounted on the aft side of both seats. Low mode timing is selected by the speed sensor. At initiation, ballistic gas which drives the arm retention take-up reel, also powers the speed sensor arming key puller which extracts the speed sensor arming key. If high mode operation is selected, the speed sensor plunger is released, firing an M99 initiator. Gas pressure from the M99 initiator is transmitted by hoses and a seat-aircraft disconnect to the control port of the normally open, gas-operated harness release mode control valve. The valve, spool-driven by the ballistic gas, moves to the high mode position which disconnects the input port (P1) from the output port (P_{OUT}). In this position, drogue chute initiator gas is blocked, thereby preventing initiation of the Mk 11 Mod 0 low mode delay. High mode time-delay initiator gas from the ballistic manifold then controls seat-man separation. Should low mode be selected, the speed sensor plunger is retained, preventing firing of the M99 initiator and thus leaving the mode select valve in the initial low mode position.

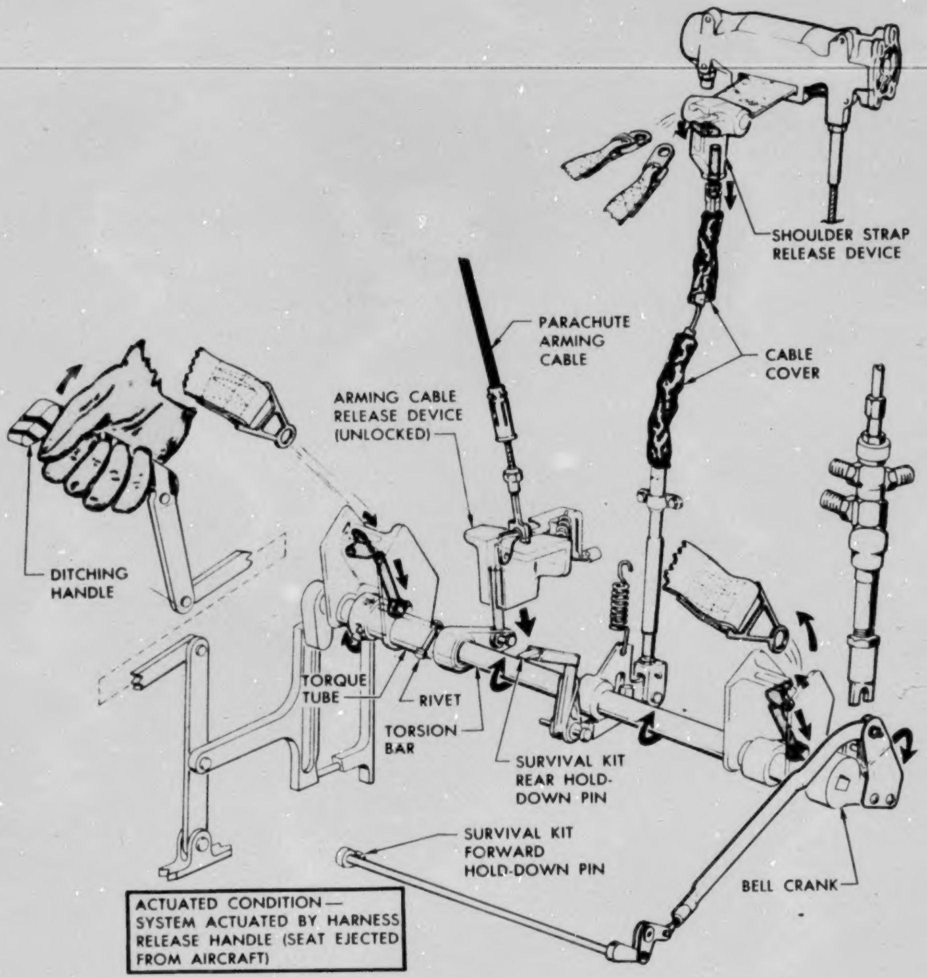
Manual Harness Release.–The manual release of the occupant from the ejection seat is controlled through the operation of the ditching handle located on the right-hand knee-raising frame. The linkage of the mechanism connected to the handle is an assembly consisting of a torsion bar within a torque tube with four levers attached to the torsion bar and one lever attached to the torque tube. (See fig. 8-78.)

The torque tube is secured to the torsion bar by a shear pin inserted through both and by a roll pin which attaches the right-hand strap release device bellcrank to the torsion bar. This pin extends through a slotted cutout in the torque tube. The harness release mechanism is


VENT
VENT
P_{OUT}
P_c
NORMAL–UPPER POSITION (P_1 TO P_{OUT}) LOW MODE
LOWER POSITION P_1 BLOCKED
P_c (PRESSURE CONTROL)

AM.1224

Figure 8-77.–Mode control (harness release).


SHOULDER STRAP RELEASE DEVICE
PARACHUTE ARMING CABLE
CABLE COVER
ARMING CABLE RELEASE DEVICE (UNLOCKED)
DITCHING HANDLE
TORQUE TUBE
RIVET
TORSION BAR
SURVIVAL KIT REAR HOLD-DOWN PIN
SURVIVAL KIT FORWARD HOLD-DOWN PIN
BELL CRANK
ACTUATED CONDITION— SYSTEM ACTUATED BY HARNESS RELEASE HANDLE (SEAT EJECTED FROM AIRCRAFT)

AM.694

Figure 8-78.—Harness release mechanism.

mounted in the seat by supports near each end of the torsion bar, allowing rotational movement of the bar.

This system was designed to release the shoulder straps, lap straps, survival kit, and parachute-arming cable when the harness release handle is operated manually with the seat installed in the aircraft. However, when the harness release handle is operated manually during seat ejection, only the shoulder harness, survival kit, and lap straps will be released. Parachute-arming cable release is prevented by the arming cable lock, which is rotated to the lock position by spring action as the seat leaves the rails. Figure 8-78 illustrates the harness release mechanism actuated with the seat ejected from the aircraft.

Separation Man-Seat.—The method of man-seat separation is through inflation of bladders. Basically, as the occupant is released from the ejection seat, two neoprene-coated bladders, one in the bottom of the seat bucket and the other on the back of the seat face, inflate and forcibly eject the occupant clear of the seat.

As previously mentioned, gas pressure from the harness release actuator initiator drives the bladder booster initiator firing pins into their cartridges. Gas pressure produced from these initiators inflates both bladders and forces the occupant out of the seat. In addition, as previously explained, the back bladder booster initiator actuates the ballistic face curtain cable cutter.

Operation

The actual ejection of the North American HS-1 seat is accomplished by either the pilot or the systems operator in the RA-5C aircraft. In the event controlled ejection is required and feasible, the pilot reduces his airspeed and orders the systems operator to prepare for ejection. After completing the required checklist, the pilot orders the systems operator to eject. This procedure is called COMMAND EJECTION.

NOTE: If for some reason it is impossible for the systems operator to perform his ejection—unconscious, wounded, etc.—actuation of the ejection system will automatically actuate the systems operator ejection seat system.

In an emergency situation requiring immediate ejection, the systems operator will initiate his own ejection. This will insure proper positioning of the body. Although there are three separate ejection controls—two hand grips and a face curtain—the face curtain should be used if possible. The face curtain insures maximum protection from wind blast.

The ejection sequence of the HS-1 ejection seat is accomplished in three distinctive steps—pre-ejection, ejection, and postejection. They are discussed in the following paragraphs.

PRE-EJECTION.—When the face curtain or initiating handgrips are actuated, the related mechanism will fire two M99 initiators located in the headrest container, or one M99 initiator located in each knee brace. These initiators are connected in parallel to preclude the possibility of system failure due to initiator failure and release gas pressure through the gaseous system. If the pilot initiates his ejection seat system, the interconnect system will initiate the aft ejection seat system and, through the ballistic-delay initiators located in the forward ejection seat system, allow the aft ejection seat to be ejected prior to the forward ejection seat. The aft ejection seat can be actuated independently of the forward seat. Initiation of the aft seat will not actuate the forward seat. When either ejection seat system is initiated, the following mechanisms are actuated simultaneously.

1. Initiator gas pressures initiate two M53 initiators. Gas pressure from these initiators initiate the knee-elevating actuators on the leg-positioning assembly. The actuators rotate the knee-raising frame up to approximately 30 degrees. During this operation, the foot retractors have pulled the occupant's feet into wells in the forward face of the seat.

2. The M53 initiator pressure also initiates a ballistic gas generator, where sufficient gas pressure is generated to exert rotational motion to the inertia reel strap drum. This rotating force causes the drum to retract the shoulder harness strap, which pulls the crewman against the back of the seat. The impact force between the crew member and the seat is controlled by a buffering device within the reel.

3. This M53 initiator gas pressure is also routed to and initiates the seat-bottoming cartridges, which provide gas pressure to the internal locking mechanism in each actuator allowing the actuator to extend. This action forces the seat bucket to the bottom of the carriage. The seat is prevented from slamming against the carriage by the buffering action of hydraulic fluid contained in both of the seat-bottoming actuators. The actuators are interconnected by a torque tube. If one actuator fails, the mechanism is unlocked mechanically by the operating actuator through the torque tube.

4. Ballistic gas pressure from the initiating system actuates another M53 initiator, which provides gas pressure to actuate the arm retention cable takeup reel cartridge. These gases initiate the ballistic charge within the reel, which causes the cable takeup reel to rotate, wind up the takeup cable, and position the occupant's arms against his chest. The arm retention cable takeup reel also contains hydraulic fluid which

acts as a buffering device to prevent abrupt action of the reel.

NOTE: On aircraft having the speed sensor incorporated, the ballistic gas pressure also actuates the speed sensor arming key puller and permits the selection of high mode, if applicable.

5. This same M53 initiator provides gas pressure to actuate the canopy emergency control valves. When actuated, these valves allow 3,000-psi air pressure from the canopy emergency air bottle to enter the canopy actuator and jettison the canopy. If the canopy fails to jettison, it will be forced open into the airstream by rollers, mounted on the seat, which trip an overcenter locking mechanism and force the canopy open as the seat travels up the rails.

6. The initiating system also provides gas pressure to ballistic-delay initiators at the two inlet port elbows of the forward catapult-rocket assembly. After a 0.75-second delay, the delay initiator cartridges initiate the forward catapult cartridge. This delay allows the initiating system gas pressure to initiate the aft catapult rocket prior to the forward catapult rocket. Dual ballistic delays of 0.320 to 0.500-second are provided internally in both catapult rockets to allow the ejection seat pre-ejection phase to be completed prior to ejection.

7. If a high mode condition exists, the speed sensor actuates, firing the M99 initiator, which provides pressure to the mode selector valve for blocking low mode operation.

EJECTION. As the seat travels up the rails, a bellcrank, which is connected to the separation system aneroid power device, is tripped by a striker plate mounted on the seat bulkhead. If the altitude at time of ejection is below approximately 13,000 feet, the aneroid mechanism will permit the delay cartridge in the separation manifold to activate. During high-altitude ejections, the aneroid power device blocks seat-man separation until the seat-man combination descends to approximately 13,000 feet.

The ballistic gaslines from the seat to the aircraft are uncoupled at quick-disconnects during the upward travel of the seat on the rails. The drogue parachute system is also initiated during upward travel of the seat on the rails. When the drogue parachute cable is fully extended, it pulls the sear pin in an M99 initiator. This initiator supplies ballistic gas to the drogue thruster, which ejects the drogue parachute. The container separates from the drogue parachute when it reaches its maximum travel.

As the seat is ejected, a lift plate pivoted on the bottom of the seat carriage opens into the airstream approximately 30 degrees and locks in this position to provide aerodynamic lift.

The seat is ejected from the aircraft in a predetermined trajectory to a safe altitude, keeping the crewmember within safe "g" tolerances. Due to a lanyard attached between the lower block and the cockpit floor, the lower block of the composite quick-disconnect is separated from the survival kit upon ejection. As the lower block of the disconnect separates, a lanyard is actuated between the intermediate block of the disconnect and the emergency oxygen bottle in the survival kit to supply the crewmember with oxygen. If ejection is above the critical ambient pressure altitude, the suit controller will utilize bailout oxygen pressure to maintain pressure suit pressure until the crewmember has descended to a safe altitude.

POSTEJECTION. The postejection operation of the escape system consists of the simultaneous operation of the drogue parachute opening and seat-man separation. After the seat separates from the rails, the following sequence of events occurs:

1. As the seat travels up the rails during the ejection operation, the drogue parachute system is initiated by a lanyard attached from the aircraft structure to the drogue thruster initiator. This causes the drogue parachute to be deployed at the time the seat separates from the rails.

2. The aneroid power device is armed by a striker as the seat travels up the rails. At 13,000 feet or below, the aneroid power device initiates the separation manifold which incorporates a 1.46-second ballistic delay to allow for seat-man deceleration. However, during high-altitude ejections, an aneroid power device blocks seat-man separation until the seat-man combination descends to approximately 13,000 feet.

For low mode ejection, the speed sensor remains inactive and the low mode time delay is initiated. In the low mode, harness release occurs immediately following rocket burnout, reducing the time to parachute deployment.

Crossover conditions for the two modes are approximately 200 knots indicated airspeed and 10,000 feet altitude.

3. After the ballistic delay, the separation manifold initiates the harness release actuator cartridge and the ejector rollers initiator.

4. Initiation of the harness release actuator cartridge produces gas pressure which ejects the foot retractors and, through the movement of connecting linkage, frees the knockout, knee-raising bar.

5. The harness release actuator piston actuates the harness release mechanism, which releases the shoulder straps, lap straps, and survival kit holddown hooks.

6. The gas pressure from the harness release actuator cartridge actuates the seat bladder initiators. This inflates the bladders and forcibly pushes the occupant from the seat. Gas pressure produced from the back bladder initiator actuates ballistically initiated face curtain cable cutters, severing the cables and releasing the face curtain.

7. When the ejector roller pins are actuated, the lower drogue parachute risers are released, allowing the drogue parachute to rotate the seat aft. The upper drogue parachute riser rings then disengage from the retaining hooks. This allows the drogue parachute to actuate a 14-foot static line and deploy the personnel parachute prior to operation of the 0.75-second ballistic-delay opener.

After the parachute is deployed, the drogue parachute static line is severed, separating the drogue parachute from the personnel parachute by a 0.5-second ballistic delay explosive cable cutter, located on the static line inside the parachute near the pack. Should the primary system of personnel parachute deployment utilizing the drogue parachute system become inoperative due to a failure of the lower drogue riser pin release, a zero delay cutter attached to the static line, left-hand side of headrest, will cut the line. This is accomplished through the force exerted as the man and parachute pack separate via the normal bladder system operation. The secondary or 0.75- second delay parachute opener will then deploy the personnel parachute.

8. As the survival kit container separates from the seat bucket, the cams which hold the arm retention latch in the receptacle are allowed to rotate. This happens as the receptacle on the survival kit container pulls out of the channel on the seat bucket. This action frees the arm retention straps which releases the arms.

Maintenance

Maintenance on the North American HS-1 ejection seat is very limited. Seat maintenance includes the removal and replacement of cartridges or other initiating devices; adjustment of seat rollers, seat actuator jackscrew rod ends, aneroid power device thruster rod ends, and survival kit holddown hooks; and operational checking of the harness takeup inertial reel, seat adjustment system, and the harness release mechanism.

There is no actual operational check of the ejection seat system, since most of the operations are accomplished by pressure from ballistic initiators. All of the ballistically operated units are one-shot items and maintenance is limited to removal and installation. In some cases, partial disassembly is necessary to check the cartridge service life expiration date. Some units on the HS-1 ejection seat cannot be disassembled for cartridge replacement or inspection—M99 type initiators, M53 type initiators, ballistically actuated face curtain cable cutters, and the catapult rocket.

The following units can be disassembled for cartridge removal, inspection, and installation: Seat-bottoming actuators, knee-elevating actuators, harness release actuator, gas generator, ballistic-delay initiators, ballistic manifold; arm retention reel, drogue parachute thruster, parachute static line cutter, drogue parachute static lanyard cutter, arm retention cable cutter, and the static line cutter.

NOTE: The spreader gun can also be disassembled on those aircraft having it incorporated.

CAUTION: Spreader gun can cause serious injury to uninformed maintenance personnel.

MAINTENANCE PRECAUTIONS.—When an AME is working on or near the ejection seat system, he must follow certain precautionary measures to protect himself as well as other personnel. The following is a list of those precautions which pertain to the North American HS-1 ejection seat:

1. The ejection seat must be removed from the aircraft prior to removing or installing any ballistic cartridge or gas-operated device.
2. Always install the safety pin harnesses and shipping safety pins in mechanical devices before removing or installing any ballistic device.
3. Always insure that safety pin harnesses are functionally complete before installing on seat assemblies. When removing a harness from the seat, always insure that none of the pins has become disengaged from the harness and accidentally left in the seat mechanism.
4. Install shipping caps on all gas fired ballistic devices when not installed on the seat.
5. Check that proper warning decals are installed on all ballistic devices.
6. Torque all ballistic device connections to the proper torque value.
7. Torque all flexible and rigid line nuts after installation.
8. Install the proper cartridge in the proper device.
9. Install check valves and ballistic devices in the correct direction.
10. In event any component of the ejection seat is initiated, all lines, check valves, fittings, and ballistic devices that contacted the propellent gases must be replaced.
11. Be sure cartridges seat freely in their breech.
12. Check for signs of leakage or damage to cartridges or cartridge seals.
13. Check for signs of oil leakage on all ballistic devices containing buffering oil.
14. Inspect breech for foreign objects on ballistic devices which have a removal cartridge.
15. Check that firing pins are installed correctly in all ballistic devices incorporating a firing pin.
16. Only qualified personnel who are thoroughly familiar with the ejection seat system should be working on the system.
17. Insure that all shipping safety pins are removed from ballistic devices after installation.

CAUTION: When performing maintenance of any type on the ejection seat, the procedures outlined in the applicable Maintenance Instructions Manual are to be adhered to.

EXPLOSIVE DEVICES

The types of explosive devices incorporated in ejection seat systems are wide and varied. The AME working with these devices must know how they function, their characteristics, how to identify them, the service life limitations, and handling methods.

In this section, the explosive devices used in the Martin-Baker H-7, ESCAPAC I, and North American HS-1 systems are discussed. Each work center involved in handling explosive devices should maintain a copy of the following references.

Current edition of:

1. NavAir 11-85-1
2. NavAir 11-100-1
3. OP 4, Vol. 2
4. OP.5, Vol. 1

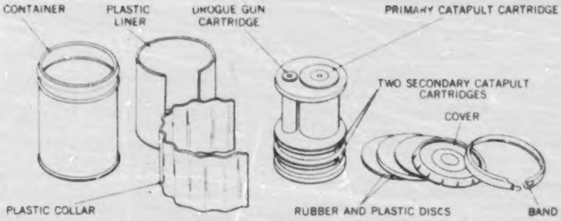
OP 4, Vol. 2 and OP 5, Vol. 1 list stowage requirements for balistics afloat and ashore.

MARTIN-BAKER EXPLOSIVE DEVICES

The cartridges reduced charge used in the Martin-Baker H-7 seat are one primary cartridge, two secondary (auxiliary) cartridges, one drogue gun cartridge, one guillotine cartridge, and one rocket motor initiator cartridge. The primary, secondary, and drogue gun cartridges are ordered and handled as sets of four, while the guillotine and rocket motor cartridges are packaged and ordered separately from the basic cartridge set when needed.

The set of four cartridges is packed in a tin can. The outside is normally painted brown, and the inside is lined with a strip of sheet plastic. The two flat secondary catapult cartridges are placed on a sponge rubber pad at the bottom of the can, one above the other, separated by a plastic disc. Primary and drogue cartridges are inserted in holes in a plastic disc suspended vertically above the secondary catapult cartridges, surrounded by a corrugated plastic collar. Figure 8-79 shows the packaging container for the Martin-Baker cartridge set.

The service life for the Martin-Baker cartridges is established at 5 years, beginning from the date of manufacture stenciled on the cartridges and on the metal container. In addition,



AM.699

Figure 8-79.–Martin-Baker cartridge set–packaging.

no more than 30 months of the 5 years shall have elapsed after opening the hermetically sealed container. Cartridges are overage if either of these time limits is exceeded. When the sealed container is opened, the service life expiration date, month and year, must be marked on the side of each cartridge.

If cartridges are packed in any other than a hermetically sealed metal container, the service life is 2 years from date of manufacture regardless of when installed.

A logbook entry is required to be made in the Martin-Baker Aeronautical Equipment Service Record on each installed explosive device. This entry includes date of manufacture, date of installation, expiration date, and the lot number of the device.

Identification

It is necessary that every pyrotechnic article be positively identified prior to installation in a firing device. Cartridges which are damaged, oversize, overage, superseded, or unidentifiable should be returned to the appropriate ordnance stowage facility for disposition.

PRIMARY CARTRIDGE.–The primary cartridge of the Martin-Baker cartridge set provides initial lifting of the ejection seat during ejection sequence.

Stamped on the face of the cartridge cap is the following data: Seat Ejection Primary No. 4 Mk 2 and MBEU/26434, followed by the name of the manufacturer.

Printed in 1/4-inch black type on the side of the cartridge case are the NavAir drawing number, reduced change lot number of the cartridge, manufacturer's symbol, inspection stamp and month and year loaded.

SECONDARY CARTRIDGES.–The first and second secondary cartridges are ignited in sequence by gaseous flame from the primary cartridge, and their firing further extends the gun barrel in ejecting the seat from the aircraft.

To aid in the identification of the cartridge, the following is printed on the face of the cartridge: Seat Ejection Secondary, No. 4 MK 2 MBEU/29236 and name of the manufacturer.

DROGUE GUN CARTRIDGE.–The drogue gun cartridge is incorporated in the drogue gun to provide the ballistic gas pressure necessary for drogue gun piston ejection and resultant deployment of the drogue parachutes.

The drogue gun cartridge is visually identified by the information stamped on the face of the cartridge–MBEU/7536, DROGUE GUN CTG.

GUILLOTINE CARTRIDGE.–The guillotine cartridge is used to sever the nylon parachute withdrawal line from the ejection seat.

The guillotine cartridge can be identified by its stamped end opposite the percussion cap end of the cartridge–MBEU/16650.

ROCKET MOTOR INITIATOR.–The rocket motor initiator, which ignites the propellant in the rocket motor which provides additional thrust to the seat ejection, is identified by markings printed in black on the face of the cartridges.

ESCAPAC EXPLOSIVE DEVICES

This section contains information concerning the explosive devices installed in the ESCAPAC ejection seat system. This system uses M99 initiators to initiate the firing of the rocket catapult and an M53 booster initiator for the harness release system.

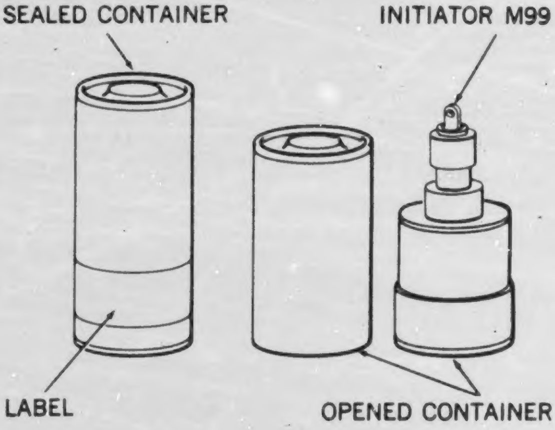
M99 Initiators

The M99 initiators are identified by a metal foil identification plate affixed to the side of the initiator and bears the following type of data: Initiator Cartridge-Actuated M99, Loader Lot No. or Device Lot No., Loaded with Cartridge (type), Cartridge Lot No., Assembly Date of Device, and sometimes the Federal Stock Number and cartridge loaded date may also appear. Refer to current NavAir 11-100-1 for lot number information and all marking information.

The service life of the M99 initiator is established at 5 years, beginning from date of original assembly, or assembly during rework, of which not more than 30 months shall have elapsed after installation in the aircraft. The initiator is overage if either of these limits is exceeded.

Log entries must be made in the aircraft logbook of the installation date, lot number, and expiration date of each M99 initiator installed in the aircraft.

M99 initiators are ordered in lots of one each and are received in a container as illustrated in figure 8-80. Safety precautions can be found in NavAir 11-100-1.



AM.700
Figure 8-80.–M99 cartridge-actuated initiator – packaging.

Harness Release Delay Cartridge, Mk 12 Mod 0

The cartridge actuated initiator is a device triggered by gas pressure from a remote source. The initiator utilizes a sealed-in Delay Cartridge, Mk 4, which, when fired, supplies gas pressure to ignite the catapult rocket of an ejection seat.

The cartridge actuated initiator consists of a constant volume chamber having a single orifice for the exit gas, a gas pressure operated firing mechanism secured in place by a shear pin, and an inlet port for connection to a pressure activation source.

Components of the cartridge actuated initiator are: a body assembly with an inlet port, gas actuated firing pin with O-ring, a shear pin held in place with a set screw and a press fitted back-up disk. The other half of the body is a constant volume chamber with an outlet port. To assemble, the two body sections are screwed together.

IDENTIFICATION AND HANDLING.–Stamped in 1/16-inch-high black letters on the body of the initiator is the following data: INITIATOR, CTG. ACTUATED MK 12 MOD 0, FSN and DoD code, initiator nomenclature, initiator drawing number, quantity, lot number, manufacturer's symbol and month and year of loading. The word INLET is steel stamped in 1/8-inch letters on the flat of the housing opposite the shear pin and set screw. The word OUTLET is steel stamped in 1/8-inch letters on the flat of the housing which falls nearest in line with the flat marked INLET at final assembly. On the adjacent flat, a flow arrow with the engraved word FLOW is engraved.

SERVICE LIFE.–Service life of Cartridge Actuated Initiator Mk 12 Mod 0 shall be 5 years from date of assembly and of which not more than 18 months shall be elapsed after opening of hermetically sealed container. The lot number on the device reflects the date of assembly and is formed in the following manner: Example - Lot No. 5-XX-0367 represents the fifth lot of the calendar year and 0367 represents the month, 3 for March, and year, 67 for 1967, of assembly.

NOTE: If packaged in other than a hermetically sealed metal container, the total service life shall be 18 months from date of manufacture, of which not more than 18 months shall have elapsed after installation.

LOG ENTRIES.—Entry shall be made in the aircraft log book of the installation date, lot number and expiration date of each cartridge installed in the aircraft.

SAFETY PRECAUTIONS.—Cartridge actuated initiators shall be handled, stored, and shipped as instruments. Cartridges shall be shipped as Class C ammunition in accordance with the general safety precautions given in the safety summary. Further information on safety precautions concerning gas generators and cartridges, rocket catapult handling can be found in the current NavAir 11-100-1 and NavAir 11-85-1.

NORTH AMERICAN EXPLOSIVE DEVICES

The North American HS-1 ejection seat system contains a variety of explosive devices. These types range from cartridge-actuated initiators, delay cartridges, impulse cartridges, and cable cutter assemblies, as well as a rocket catapult.

These explosive devices, like the explosive devices in both the Martin-Baker and the ESCAPAC ejection seats, require replacement at specified time intervals. Before installing any ballistic unit, check the service life expiration date of the new unit. Avoid installing items with a service life less than the next periodic inspection interval.

Cartridge-Actuated Initiator M53

The M53 initiator is a cartridge-actuated, gas-producing device triggered by gas pressure from a remote source. It is used to actuate a ballistic gas generator, knee- elevating actuators, etc., or another initiator remotely located, and to which it is connected by rigid or flexible tubing.

To identify the initiator, a metal foil identification plate is affixed to the side of the initiator. This tag bears the following information:

1. Initiator, Cartridge-Actuated, M53.
2. Loader's Lot No. or Device Lot No.

NOTE: The loader's lot generally indicates the assembly date; for example, 6-M-3-67. The (6) indicates the reworking facility, and the last numbers would indicate the date of assembly.

3. Applicable cartridge nomenclature.
4. Cartridge Lot No.

The service life of the M53 initiator is established at 5 years, beginning from the date of original assembly, or assembly during rework. Of this 5 years, no more than 30 months shall have elapsed after installation in an aircraft.

Cartridge-Actuated Initiator M99

The M99 initiator is a mechanically fired pressure developing source. It is used to actuate a catapult, remover, thruster, etc., or another initiator remotely located, and to which it is connected by rigid or flexible tubing.

NOTE: The identification data and service life requirements are identical to those of the M53 initiator and the M99 described earlier for the ESCAPAC seat system.

Delay Cartridges Mk 76 Mod 0, Mk 101 Mod 0, and Mk 4 Mod 1

The North American HS-1 seat system uses three types of delay cartridges. The Mk 76 Mod 0 delay cartridge actuates the harness release actuator and the ballistic ejector roller initiator to effect seat-man separation during the ejection sequence. The Mk 101 Mod 0 cartridge is installed in the parachute static line ballistic cutter. This cutter severs the 14-foot static line during emergency escape from the aircraft. The Mk 4 Mod 1 cartridge is used to actuate an automatic parachute release.

All three cartridges are similar in construction, and the main difference is the delay column found in the construction of the cartridges. The Mk 76 cartridge has a 1.70-second delay, the Mk 101 cartridge has a 0.5-second delay, while the Mk 4 cartridge has a 0.75- second delay.

These cartridges are identified by the following information stamped on the cartridge case: type of cartridge, lot number, manufacturer's symbol, and the month and year the cartridge was filled.

Service life of these cartridges is established at 5 years, beginning from the date of manufacture stamped on the cartridge, of which not more than 18 months shall have elapsed after opening of the hermetically sealed container. When the hermetically sealed container is opened, the service life expiration date must be marked with indelible ink on the side of each cartridge.

If the cartridges are packaged in other than a hermetically sealed metal container, the total service life is 2 years from date of manufacture. No more than 18 months of the 2 years shall have elapsed after installation in the device.

Impulse Cartridges

The North American HS-1 seat system incorporates several types of impulse cartridges. Generally, they are similar in construction. They all contain a primer, booster charge, and a main charge. One of these cartridges is the Mk 40 Mod 0, used to actuate the harness and foot-retainer release actuator after the ejection seat has been catapulted from the aircraft.

All impulse cartridges have the following information stamped on the cartridge case and/or on the metal shipping container:

1. Name of cartridge.
2. Mark and modification number.
3. Lot number.
4. Manufacturer symbol.
5. Loading date.

The service life for the impulse cartridges used in the HS-1 ejection seat is established at 5 years, beginning from the date of manufacture stamped on the cartridge and on the hermetically sealed container. No more than 30 months of the 5 years shall have elapsed after opening of the hermetically sealed container. When the sealed container is opened, the service life expiration date must be marked with indelible ink on the side of each cartridge.

NOTE: If the cartridges are packaged in other than a hermetically sealed metal container, the service life is 30 months from the date of manufacture regardless of when installed.

SAFETY PRECAUTIONS

Ejection seats have several inherently dangerous features which are a definite hazard to uninformed and/or careless personnel. Consequently, whenever the aircraft is on the ground, all safety pins must be installed and not removed until the aircraft is ready for flight. Caution must be observed at all times during maintenance of and around the seats to avoid injury and equipment damage by explosive devices of the seat. Safety precautions and correct procedures cannot be overemphasized.

Keep all cartridges away from live circuits. Under no circumstances should any person reach within or enter an enclosure for the purpose of servicing or adjusting equipment without the immediate presence or assistance of another person capable of rendering aid.

When removing cartridges for inspection or safety reasons, they must be marked for identification so they can be reinstalled in the same device from which removed. Under no circumstances should an unmarked or unidentified cartridge be installed in any cartridge- actuated device.

Cartridges should be handled as little as practicable to minimize risk of fire, explosion, and damage from accidental causes. All safety devices must be kept in good order and used only as designated.

Cartridges must be stored where they will not be exposed to the direct rays of the sun, and be protected from extremely high temperatures. When in containers, they must be stored in a cool, dry place where they can be readily inspected.

The seat must always be disarmed before removal from the aircraft or firing of the seat may occur. While handling percussion-fired cartridges, extreme caution must be exercised not to drop cartridges as they can fire upon impact.

CHAPTER 9

MISCELLANEOUS UTILITY SYSTEMS

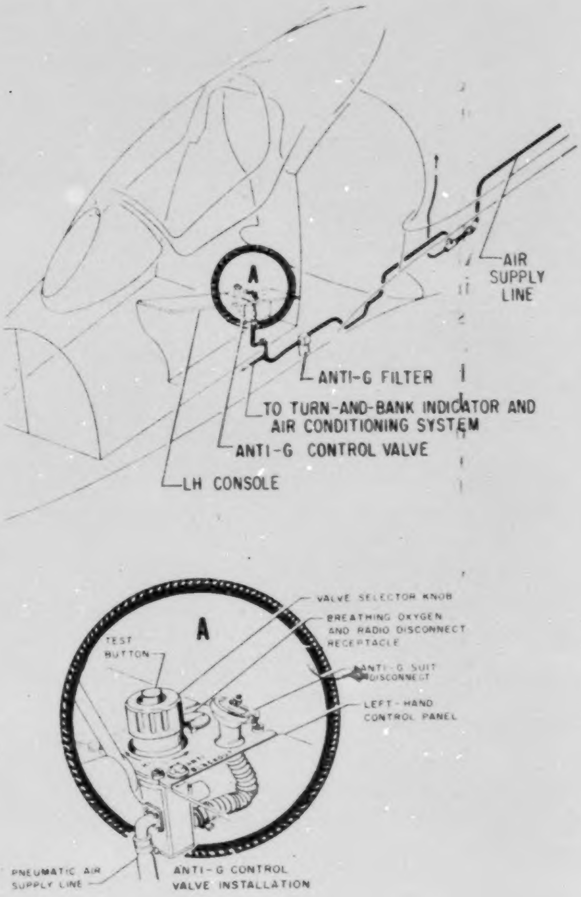
ANTI-G SYSTEMS

The anti-g system supplies and controls the flow of air pressure to the pilot's anti-g suit to compensate for forces exerted upon the human body during flight conditions. This system is designed to accomplish the following fourfold purpose:

1. Provide protection against greyout, blackout, and unconsciousness.
2. Alleviate fatigue and decreased mental alertness which may result from repeated accelerations below the blackout level.
3. Provide a method by which the pilot may relieve leg stiffness and physical tension during flight.
4. Provide the pilot with a physical indication of the approximate acceleration to which the aircraft is being subjected.

TYPICAL ANTI-G SYSTEM

The anti-g system used in some aircraft is similar to the one illustrated in figure 9-1. This system consists of a supply line, an air filter, a pressure regulating valve, a connecting hose, and a suit attachment fitting (single quick disconnect or composite quick disconnect). The air pressure used in this system may be taken directly from the engine compressor bleed-air ducting, but is usually taken off the air-conditioning ducting down-stream from the heat exchanger.


A
AIR SUPPLY LINE
ANTI-G FILTER
TO TURN-AND-BANK INDICATOR AND AIR CONDITIONING SYSTEM
ANTI-G CONTROL VALVE
LH CONSOLE
A
TEST BUTTON
VALVE SELECTOR KNOB
BREATHING OXYGEN AND RADIO DISCONNECT RECEPTACLE
ANTI-G SUIT DISCONNECT
LEFT-HAND CONTROL PANEL
PNEUMATIC AIR SUPPLY LINE
ANTI-G CONTROL VALVE INSTALLATION

AM.702

Figure 9-1.—Typical anti-g system.

Pressure Regulating (Anti-G) Valves

There are two types of anti-g valves used on the various naval aircraft. One type has a dual pressure range (HI or LO) which may be controlled by the pilot. The other type has a fixed pressure output which corresponds roughly to the high (HI) pressure output of the dual pressure valve. Both valves perform the dual functions of regulating the air pressure received from the aircraft bleed-air system and metering this pressure in varying amounts proportional to the g forces exerted upon the aircraft and its occupants.

ANTI-G VALVE (AN6538-2).—This dual range pressure regulating valve is a standard stock item which may be used on different types of aircraft. In some cases, it is necessary to modify this valve in accordance with the applicable Maintenance Instructions Manual to adapt it to a particular aircraft.

A knob on the top of the valve controls the pressure output. The knob is rotated to select either HI or LO pressure output. (See fig. 9-2.) A button on top of the valve allows the pilot to test the operation of the system. Also, pressing this button from time to time during flight produces a massaging effect which will relieve the pilot's leg stiffness and physical tension.

ANTI-G VALVE (SINGLE STAGE).—This is a single stage valve which utilizes the high pressure features of the AN6538-2 anti-g valve. This valve is illustrated in figure 9-3.

The single stage valve opens when the aircraft is subjected to approximately 1.5 positive g's.

This valve is designed to receive air pressure from the bleed air system at varying pressures. A relief valve, shown in figure 9-4, relieves air pressure in excess of 11 psi in the valve outlet chamber. Figure 9-4 illustrates the operation of this valve.

For further information on the operation of anti-g valves, detailed coverage is provided in Aviation Structural Mechanic E 3 & 2, NavTra 10309-C, chapter 6.

Anti-G System Filter

Most anti-g systems utilize a filter to prevent particles of dust, trash, and other foreign material from entering the regulating valve. This filter may be located in the supply line, as shown in the typical system illustrated in figure 9-1, or may be attached to the anti-g valve on the inlet side. A typical anti-g system filter is shown in figure 9-5. The filter element is removable and should be changed at the interval prescribed in the applicable MRC deck or as specified in the Maintenance Instructions Manual.

Quick Disconnects

Connection of the anti-g suit to the anti-g system is accomplished by means of a quick-disconnect coupling. This disconnect may be either a single unit which connects the anti-g suit only, or it can be a composite quick disconnect which connects the pilot to the various personal service lines (oxygen, ventilation, anti-g system, and communications).

ANTI-G QUICK DISCONNECT.—The anti-g system quick disconnect is designed to provide a quick method of connecting and disconnecting the pilot's anti-g suit to the anti-g system. In some installations, the quick disconnect protrudes through the pilot's console and is attached by a flexible hose to the outlet port of the anti-g pressure regulating valve. The disconnect can be pulled up to a bumper stop on the hose for making the connection to the anti-g suit. A spring-loaded cover prevents the entry of foreign matter when the disconnect is not being used. (See fig. 9-1.)

COMPOSITE QUICK DISCONNECT.—The new high-performance aircraft utilize a composite quick disconnect to provide a single point connection for all of the previously mentioned systems.

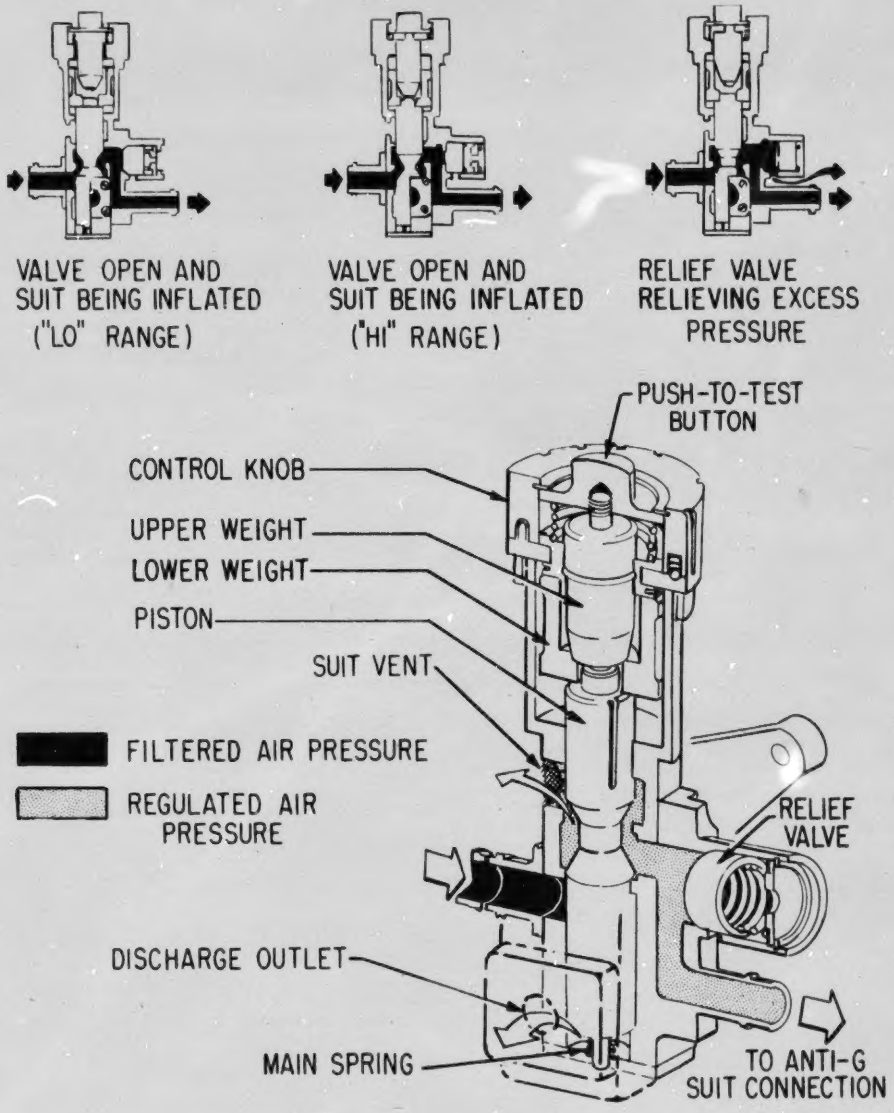
The composite quick disconnect is illustrated in figure 9-6. Some quick disconnects provide a connection point for only one or more of the systems previously mentioned. Remaining system connections are located on the left or right cockpit consoles as necessary to provide easy connecting and disconnection.

This quick disconnect consists of three separate blocks. A complete description of the operation of quick disconnects is covered in Aviation Structural Mechanic E 3 & 2, NavTra 10309-C, chapter 6.

ANTI-G SYSTEM MAINTENANCE

Maintenance of the anti-g system consists mainly of removal and installation of valves and lines and servicing the filter.

Component repair of the anti-g valve is limited because of the equipment necessary to test the valve. Component repair of the dual range anti-g valve is not recommended at all. The single stage anti-g valve may be repaired at


VALVE OPEN AND SUIT BEING INFLATED ("LO" RANGE)
VALVE OPEN AND SUIT BEING INFLATED ("HI" RANGE)
RELIEF VALVE RELIEVING EXCESS PRESSURE
PUSH-TO-TEST BUTTON
CONTROL KNOB
UPPER WEIGHT
LOWER WEIGHT
PISTON
SUIT VENT
■ FILTERED AIR PRESSURE
▨ REGULATED AIR PRESSURE
RELIEF VALVE
DISCHARGE OUTLET
MAIN SPRING
TO ANTI-G SUIT CONNECTION

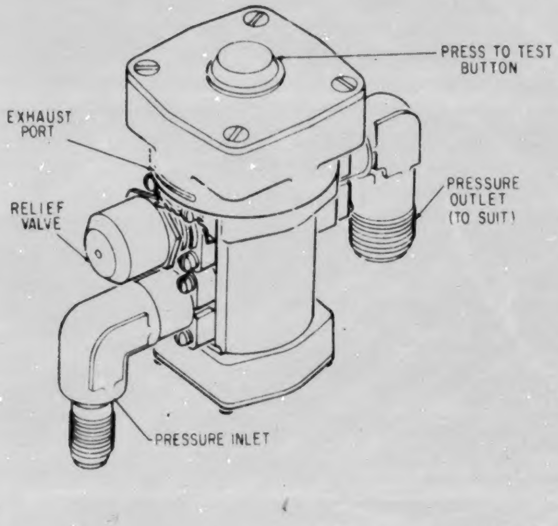
AM.703

Figure 9-2.–Anti-g valve (Two stage/dual range).

intermediate maintenance activities having the necessary test equipment.

Servicing

The anti-g filter element should be replaced at periodic intervals, or when the element becomes clogged or dirty. The replacement interval is specified in the applicable Maintenance Instructions Manual. If the filter is removed from the aircraft to replace the filter element, care should be taken to insure that the filter is reinstalled properly. (The inlet and outlet ports are iden-


PRESS TO TEST BUTTON
EXHAUST PORT
PRESSURE OUTLET (TO SUIT)
RELIEF VALVE
PRESSURE INLET

AM.704
Figure 9-3.–Anti-g valve (single stage).

tified as IN and OUT to facilitate installation for proper direction of airflow.) After replacing the filter element, a thorough check should be made to insure that no air leaks exist.

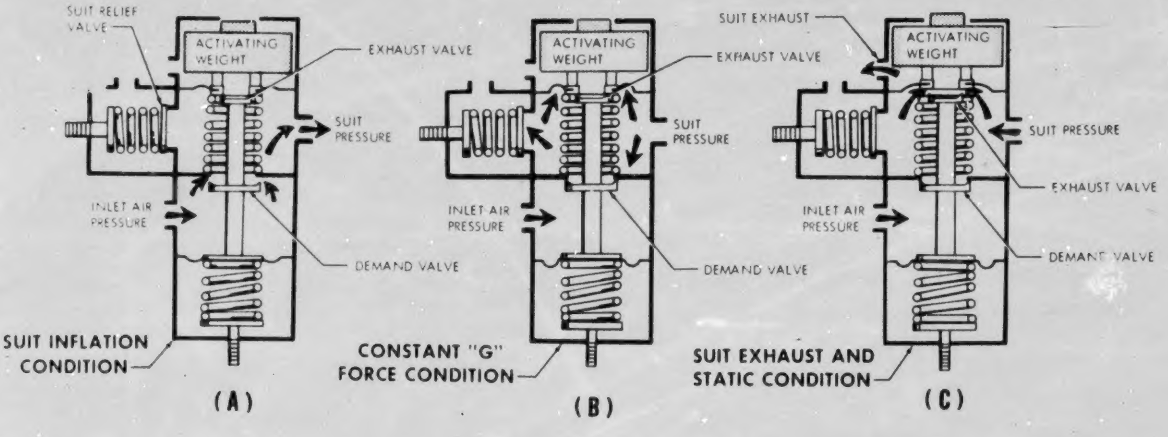
Testing

When installing the dual range anti-g valve, the following test should be performed:

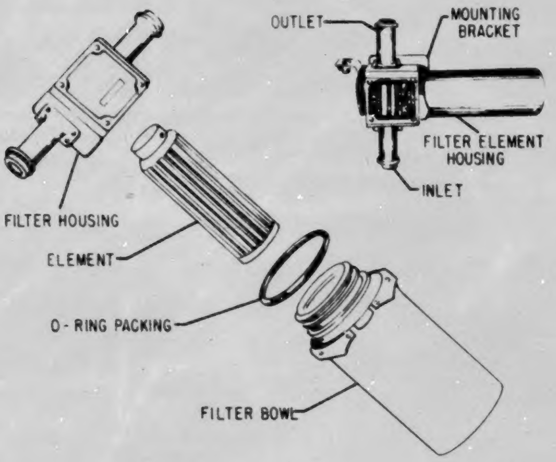
1. Select the LO position by rotating the control knob counterclockwise until the mechanical stop is reached.
2. Hold the valve in the vertical position and give it a sudden forceful, downward shake. If the valve is operating properly, the piston and lower weight inside the valve can be heard to drop down and then return to its original position. This movement can be felt and heard very easily.
3. Select the HI position by rotating the control knob clockwise until the mechanical stop is reached.
4. Hold the valve in the vertical position and give it a sudden forceful, downward shake. If the valve is operating properly, not only the piston and lower weight, but also the upper weight and pushbutton inside the valve can be heard to drop down and then return to the original position.

Operational Check

An operational check of the anti-g system is performed with the aircraft engine running by pressing the test button on top of the valve to


SUIT RELIEF VALVE
ACTIVATING WEIGHT
EXHAUST VALVE
SUIT PRESSURE
INLET AIR PRESSURE
DEMAND VALVE
SUIT INFLATION CONDITION
(A)
ACTIVATING WEIGHT
EXHAUST VALVE
SUIT PRESSURE
INLET AIR PRESSURE
DEMAND VALVE
CONSTANT "G" FORCE CONDITION
(B)
SUIT EXHAUST
ACTIVATING WEIGHT
SUIT PRESSURE
EXHAUST VALVE
INLET AIR PRESSURE
DEMAND VALVE
SUIT EXHAUST AND STATIC CONDITION
(C)

AM.705
Figure 9-4.–Single stage anti-g valve schematic.



AM.706

Figure 9-5.—Anti-g system filter.

ascertain if there is proper airflow from the system. When the test button is depressed, the amount of airflow from the disconnect should be proportional to the amount the button is depressed, which indicates that the anti-g valve is operating properly. On aircraft which utilize the dual range anti-g valve, this test should be performed in both the high (HI) and low (LO) range.

CANOPY PRESSURE SEALING SYSTEMS

The canopy pressure sealing system is designed to provide an airtight seal between the canopy frame and the fuselage structure. Most canopy sealing systems consist of a rubber seal, a combination pressure regulator and shutoff valve, and various attaching fittings.

Pressure sealing is accomplished by utilizing partially cooled engine bleed-air to inflate a flexible rubber seal in the crevice between the canopy frame and the fuselage structure. The pressure seal generally is attached to a retainer around the edge of the canopy frame and mates with a jam around the upper edge of the cockpit opening. Air pressure to inflate the seal is controlled by a pressure regulator valve. When the canopy is closed, the regulator valve is opened and air pressure is supplied to inflate the seal; when the canopy is opened, the valve is actuated, closing the pressure source and venting the air pressure in the seal into the cockpit.

There are two types of canopy pressure sealing systems used on various pressurized aircraft. These systems are classified as to the method of actuation—mechanical and electrical.

MECHANICALLY ACTUATED CANOPY SEAL SYSTEM

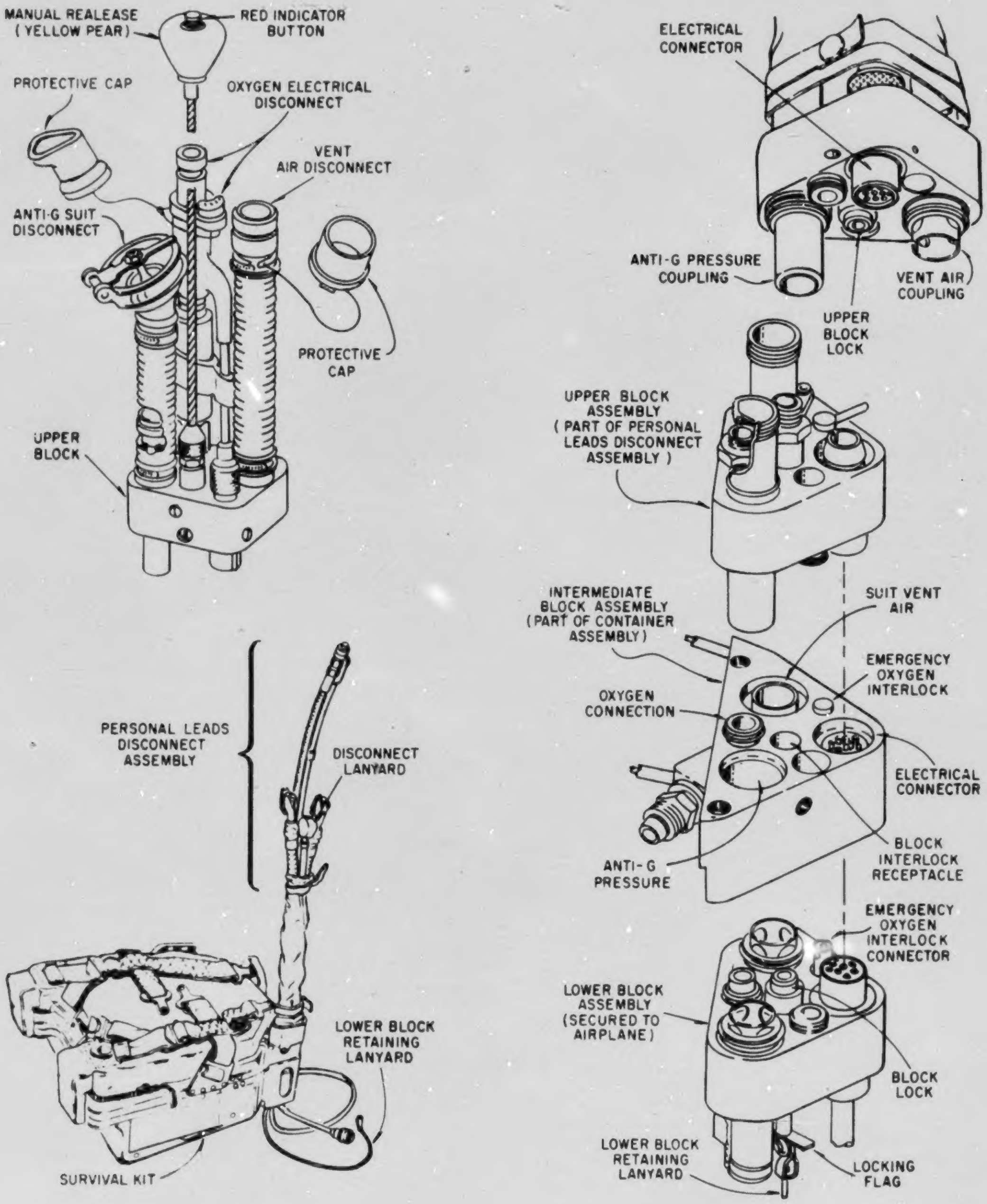
A mechanically actuated canopy seal system is illustrated in figure 9-7. This system is controlled by a regulator valve which is actuated by the canopy operating mechanism in unison with the opening and closing of the canopy.

Canopy Pressure Seal Regulator Valve

The canopy pressure seal regulator valve is shown in the system schematic in figure 9-8. This valve reduces the source of air pressure supplied to inflate the pressure seal and provides the control by which the seal is inflated and deflated in unison with closing and opening of the canopy.

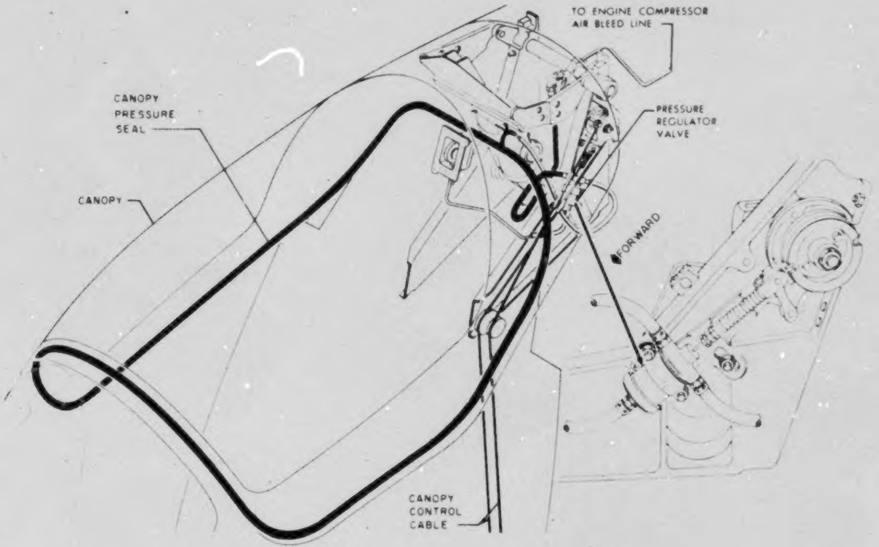
The canopy pressure seal regulator valve has three ports, identified as INLET, OUTLET, and VENT. A valve stem on the valve housing (fig. 9-8) is actuated by the canopy control mechanism to control the flow of air pressure through the valve. When the valve stem is not depressed (canopy closed), air flowing through the valve to the canopy pressure seal is reduced to approximately 13 psi by passing through a variable orifice that becomes smaller as the engine bleed-air pressure increases. The size of the orifice is controlled by a bellows which is vented into the cockpit. If the valve fails, the bellows compresses when the pressure in the seal reaches approximately 16 psi, causing the INLET port to close and the VENT port to open, thus relieving the pressure in the seal to the cockpit.

When the valve stem is depressed by the canopy mechanism (canopy open), the bellows


MANUAL REALEASE
(YELLOW PEAR)
RED INDICATOR BUTTON
PROTECTIVE CAP
OXYGEN ELECTRICAL DISCONNECT
VENT AIR DISCONNECT
ANTI-G SUIT DISCONNECT
PROTECTIVE CAP
UPPER BLOCK
ELECTRICAL CONNECTOR
ANTI-G PRESSURE COUPLING
VENT AIR COUPLING
UPPER BLOCK LOCK
UPPER BLOCK ASSEMBLY (PART OF PERSONAL LEADS DISCONNECT ASSEMBLY)
INTERMEDIATE BLOCK ASSEMBLY (PART OF CONTAINER ASSEMBLY)
SUIT VENT AIR
EMERGENCY OXYGEN INTERLOCK
OXYGEN CONNECTION
ELECTRICAL CONNECTOR
BLOCK INTERLOCK RECEPTACLE
ANTI-G PRESSURE
PERSONAL LEADS DISCONNECT ASSEMBLY
DISCONNECT LANYARD
LOWER BLOCK RETAINING LANYARD
SURVIVAL KIT
EMERGENCY OXYGEN INTERLOCK CONNECTOR
LOWER BLOCK ASSEMBLY (SECURED TO AIRPLANE)
BLOCK LOCK
LOWER BLOCK RETAINING LANYARD
LOCKING FLAG

AM.1149

Figure 9-6.–Composite quick disconnect.



AM.708

Figure 9-7.—Mechanically actuated canopy seal system.

is depressed by the stem, opening the VENT port to relieve the seal pressure.

When there is a loss of air pressure to the INLET port, the bellows will expand and retain the existing air pressure in the canopy seal.

Canopy Seal

An inflatable canopy pressure seal is installed on the canopy to provide for sealing the crevice between the canopy frame and the fuselage frame. This seal is made of a silicone rubber and is designed for installation on the canopy without the use of adhesives. The seal is attached by inserting the molded flange into a channel installed on the canopy. (See fig. 9-9.) This flange-to-channel arrangement facilitates easy removal and installation of the canopy seal. This type seal is used on most of the pressurized aircraft in current use.

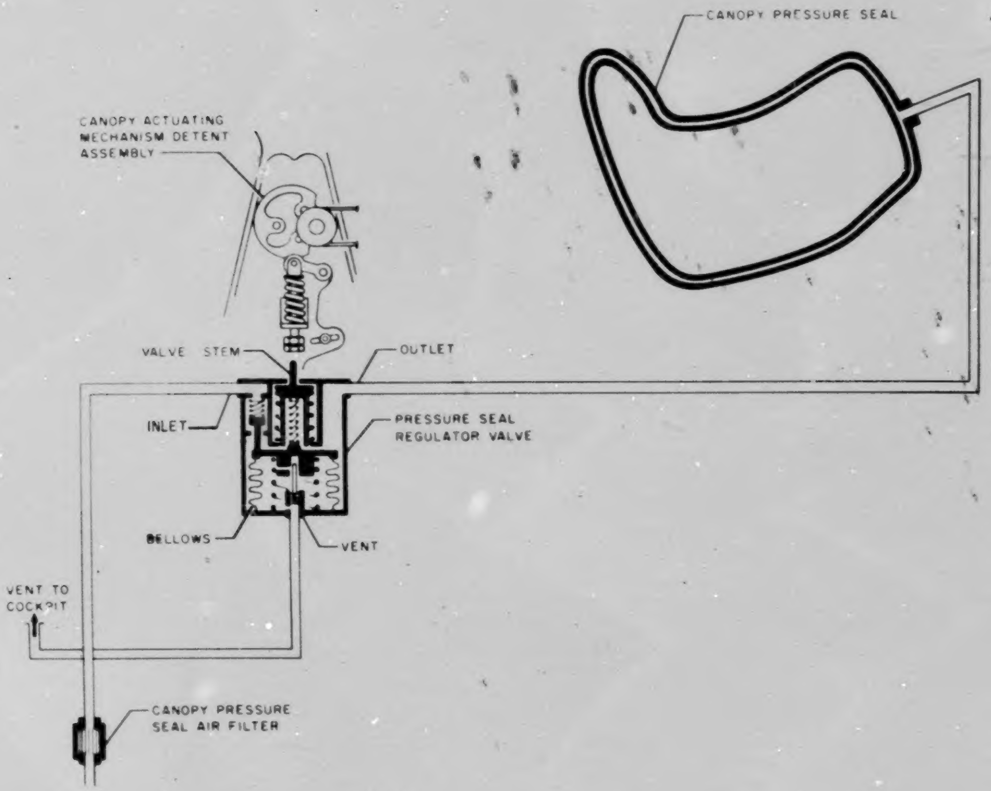
The canopy pressure seal is attached to the system by means of a short piece of tubing which extends from the interior of the seal through the bead. Treads on the seal contacting surface (fig. 9-9) mate with the surface of the cockpit frame to provide increased sealing qualities when the canopy is closed and the cockpit is pressurized.

Leaks in the canopy pressure seal may be detected by closing and locking the canopy/canopies and connecting an external air source and a rate-of-flow meter to the canopy seal ground test fitting and pressurizing the canopy seal to 20 psi.

Shut off air source and check for a pressure loss after a 15-minute period. A leakage rate of 2.0 psi is allowable for this time, but if it is in excess of this, check for leaks in the system, using a soap (MIL-S-4282) and water solution on the seal and fittings.

Cabin pressure seals that are in excessive leakage are replaced, and defective seals are returned to supply for proper screening.

Installation of the canopy seal should be accomplished by utilizing a tool fabricated from phenolic sheet stock or some other material which will not damage the seal. Use of sharp metal tools will tend to cut the flanges of the


CANOPY PRESSURE SEAL
CANOPY ACTUATING MECHANISM DETENT ASSEMBLY
VALVE STEM
OUTLET
INLET
PRESSURE SEAL REGULATOR VALVE
BELLOWS
VENT
VENT TO COCKPIT
CANOPY PRESSURE SEAL AIR FILTER

AM.709

Figure 9-8.–Mechanically actuated canopy seal system schematic.

seal. The aircraft Maintenance Instructions Manual will include the necessary instructions for fabricating this seal installation tool.

Canopy Pressure Sealing System Air Filter

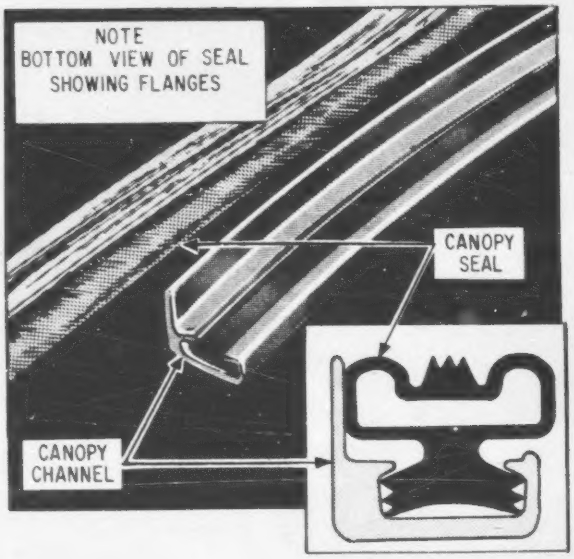
The canopy pressure system illustrated in figure 9-8 utilizes an air filter to remove particles of foreign matter from the engine bleed air that is directed to the canopy pressure seal. This filter consists of a cylindrical housing containing a corrosion- resistant steel wire filter element which is would on a frame. The housing of the filter is marked with an arrow to indicate the proper direction of airflow.

Maintenance

Maintenance of the mechanically actuated canopy seal system consists of servicing, troubleshooting, and removal and installation of components.

SERVICING.–Servicing is limited to cleaning the air filter and the canopy seal.

The air filter should be cleaned periodically as specified by the applicable Periodic Maintenance Requirements Manual. Cleaning of this filter may be accomplished either by disassembling the filter and brushing the element lightly with a soft bristled brush, or by directing a light blast of air through the filter element in the direction opposite to the arrow on the filter housing.



AM.710

Figure 9-9.—Canopy seal.

The canopy seal should be cleaned periodically to insure positive sealing and to protect the rubber seal against damage from accumulations of dirt and foreign materials. Cleaning of most canopy seals may be accomplished by using a solution of mild soap and water or naphtha.

Certain types of canopy seals require weatherproofing. Weatherproofing should be done only as specified in the applicable Maintenance Instructions Manual since the solvents used in the weatherproofing materials and cleaners are harmful to some types of seals.

TROUBLESHOOTING.—Troubleshooting of the canopy pressure seal system should be accomplished by utilizing the system schematic and the troubleshooting chart supplied by the aircraft manufacturer in the applicable Maintenance Instructions Manual. Table 9-1 illustrates the troubleshooting chart recommended by one aircraft manufacturer. Troubleshooting is normally accomplished by utilizing an external source of pressurized air regulated to a pressure of 20 to 40 psi.

ELECTRICALLY ACTUATED CANOPY SEAL SYSTEM

An electrically actuated canopy pressure seal system is illustrated in figure 9-10. This type system is controlled by a pressure regulator and dump valve assembly which consists of a pressure regulator, a solenoid poppet shutoff and vent valve, and a relief valve.

Canopy Pressure Seal Regulator Valve

The canopy seal air pressure regulator valve controls the pressurizing and depressurizing of the canopy seal, depending upon the canopy position. The pressure regulator consists of a spring loaded diaphragm which controls a poppet valve to admit the correct air pressure to the canopy seal. An adjustment screw is provided at the top of the regulator housing to adjust the output of air pressure.

The shutoff and dump valve consists of a solenoid-operated poppet valve which is spring loaded to the closed position. When the solenoid is energized (fig. 9-10 (A)), the dump valve closes the vent port and opens the regulator shutoff to permit inflation of the canopy seal. The outlet pressure is maintained at approximately 20 psi by the pressure regulator.

When the solenoid is deenergized by the opening of the canopy (view B), the dump valve opens the vent port, closes the regulator shutoff to stop the flow of supply air, and dumps the pressure in the canopy overboard through the vent line. The relief valve feature of the pressure regulator prevents seal pressure from becoming excessive during rapid altitude changes by venting the seal pressure overboard when the pressure reaches a maximum of 22 psi (view C).

In case of an electrical failure, the regulator valve is spring loaded in the dump position.

Ground Test Connections

Most canopy pressure seal systems have ground test connections which are used to ground test the system and to pressurize the system during carrier deck storage. The ground test connections (fig. 9-11) are usually located on the cabin air pressure test panel. One

Table 9-1.–Troubleshooting chart for a mechanically actuated canopy seal system.

Trouble	Probable cause	Remedy
1. Cockpit will not pressurize.	1. Damaged canopy pressure seal.	1. Replace the seal.
	2. Pressure seal regulator valve clogged.	2. Replace the valve.
	3. Air filter clogged.	3. Clean or replace the filter.
2. Canopy pressure seal partially inflated.	Same probable cause and remedy as for trouble number 1.	
3. Canopy pressure seal will not inflate.	Same probable cause and remedy as for trouble number 1.	

connection is utilized for ground test; and the other, which is normally the seal vent, is used for ground pressurization of the canopy seal.

Maintenance

Maintenance of the electrically actuated system, like the mechanical system, consists mainly of servicing, troubleshooting, and removal and installation of components. The applicable aircraft Maintenance Instructions Manual furnishes such information as proper procedure, manpower requirements, materials lists, tool and equipment lists, quality assurance instructions, and maintenance level instructions for the disposition of the defective parts. Examples of general procedures and precautions are presented in the following paragraphs.

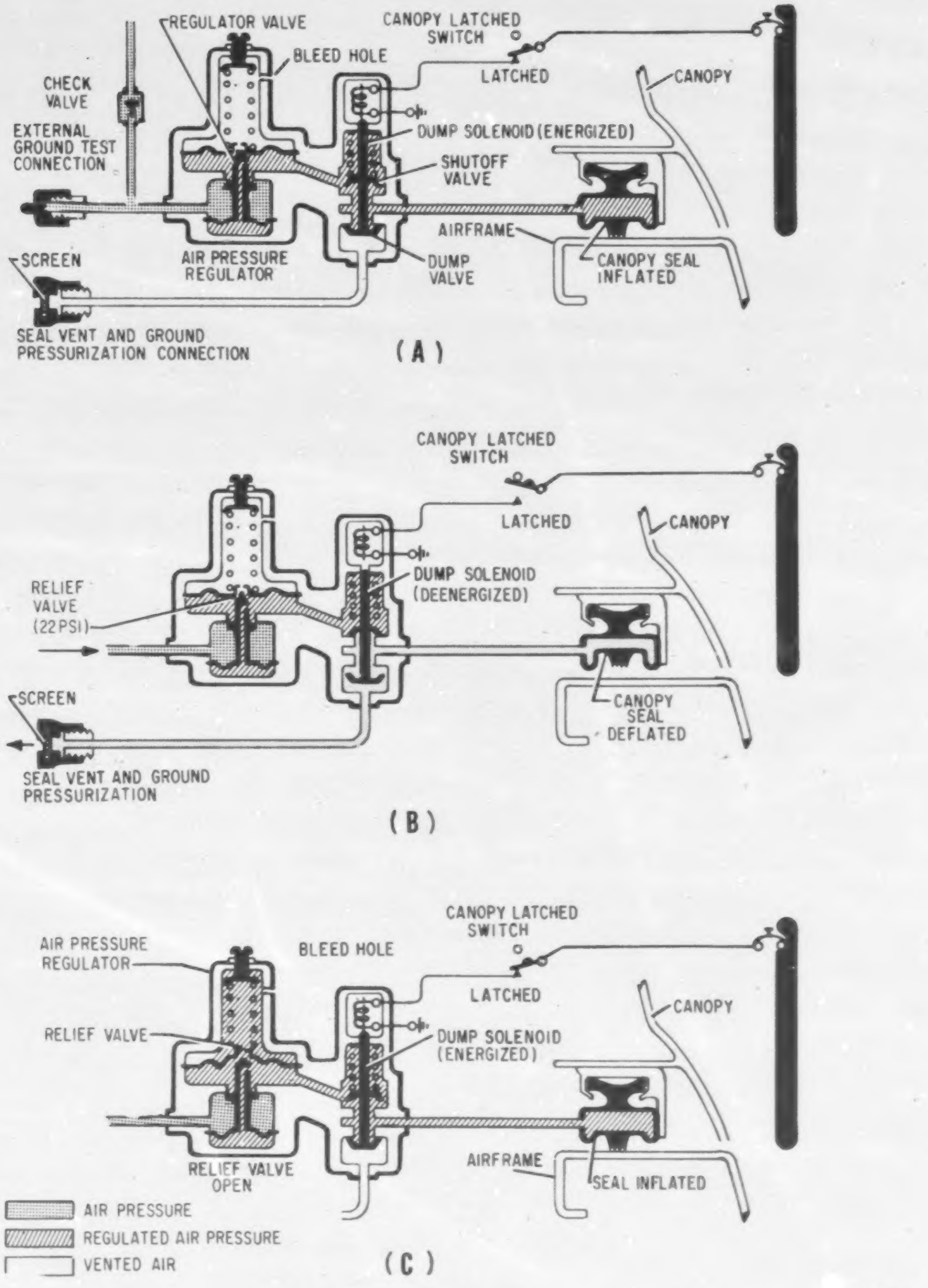
SERVICING.–Servicing is limited to cleaning the canopy seal, ground inflating the canopy seal, and periodic inspections for visible defects and dirt or foreign material accumulations. All major components of the system are self-sustaining and require no general servicing between overhaul periods for normal operation.

When pressurized type aircraft are stowed on the carrier flight deck without canopy covers, the canopy seal should be inflated externally to protect the cabin area.

Ground pressurization of the canopy seal is accomplished by attaching an external air source to the canopy seal vent and ground pressurization fitting (fig. 9-11). Since air pressure applied to this fitting bypasses the system regulator (fig. 9-12), the air source must be controlled to less than 20 psi. More than 20 psi pressure could rupture the seal. Review chapter 6 of AME 3 & 2 for more detailed information on ground pressurization of canopy seal systems.

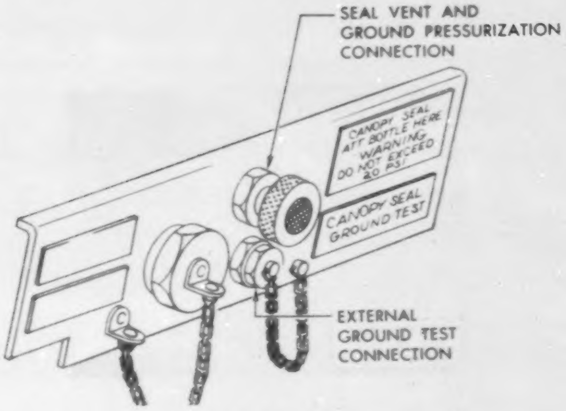
TROUBLESHOOTING.–Troubleshooting charts similar to the one in table 9-2 are found in most aircraft Maintenance Instructions Manuals. The troubleshooting chart is provided as an aid in determing the cause, isolation procedure, and remedy for the more common malfunctions within the canopy seal system. When a malfunction is suspected, always insure that the proper controls have been activated to provide proper operating potential to the unit to be inspected.

REMOVAL AND INSTALLATION PROCEDURES.–The aircraft Maintenance Instructions Manual provides the instructions and visual aids necessary to remove and install the various components of the canopy seal system. In addition to instructions, a list of important associated information such as disposition of defective parts, tools and equipment require-


REGULATOR VALVE
CANOPY LATCHED SWITCH
BLEED HOLE
LATCHED
CANOPY
CHECK VALVE
EXTERNAL GROUND TEST CONNECTION
DUMP SOLENOID (ENERGIZED)
SHUTOFF VALVE
AIRFRAME
SCREEN
AIR PRESSURE REGULATOR
DUMP VALVE
CANOPY SEAL INFLATED
SEAL VENT AND GROUND PRESSURIZATION CONNECTION
(A)
CANOPY LATCHED SWITCH
LATCHED
CANOPY
DUMP SOLENOID (DEENERGIZED)
RELIEF VALVE (22 PSI)
SCREEN
CANOPY SEAL DEFLATED
SEAL VENT AND GROUND PRESSURIZATION
(B)
AIR PRESSURE REGULATOR
BLEED HOLE
CANOPY LATCHED SWITCH
LATCHED
CANOPY
RELIEF VALVE
DUMP SOLENOID (ENERGIZED)
AIRFRAME
RELIEF VALVE OPEN
SEAL INFLATED
AIR PRESSURE
REGULATED AIR PRESSURE
VENTED AIR
(C)

AM.711

Figure 9-10.—Electrically actuated canopy seal system.


SEAL VENT AND
GROUND PRESSURIZATION
CONNECTION
CANOPY SEAL
AIR BOTTLE HERE
WARNING
DO NOT EXCEED
20 PSI
CANOPY SEAL
GROUND TEST
EXTERNAL
GROUND TEST
CONNECTION

AM.712

Figure 9-11.–Cabin air pressure test panel.

ments, and quality assurance instructions is also provided.

When removing a unit from the aircraft, always insure that proper measures are taken to prevent the entry of dirt and foreign material into ports and ducts that have been opened to accommodate removal.

DEFROSTING, ANTI-ICING, AND RAIN REMOVAL SYSTEMS

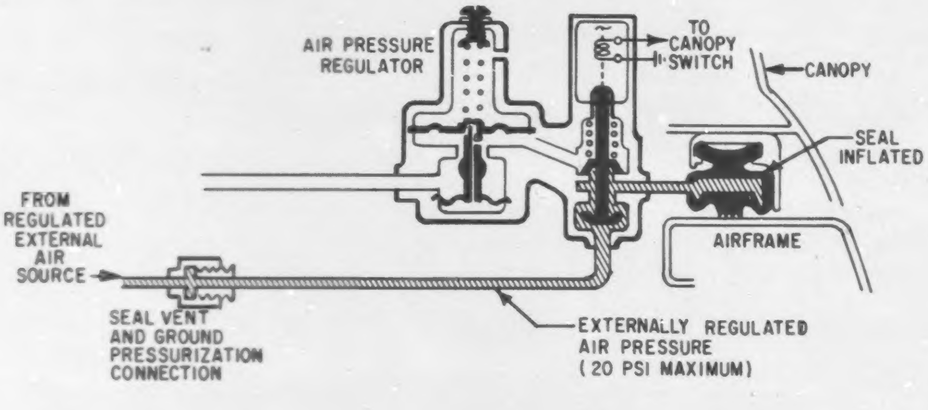
The windshield and canopy defrost, anti-ice, and rain removal systems provide conditioned, controlled air to the pilots' cockpit, upon demand, for eliminating ice or rain from the windshield exterior surfaces and to eliminate frost from the windshield and canopy interior surfaces.

The windshield and canopy defrost, anti-ice, and rain removal systems (fig. 9-13) are two separately controlled systems fed by one common supply duct from the primary cooling system.

The windshield and canopy defrost, anti-ice, and rain removal systems described in this text utilize two sets of controls. One set of controls operates the windshield and canopy defrost system and the other operates the anti-ice and rain removal system.

WINDSHIELD AND CANOPY DEFROST SYSTEM

The windshield and canopy defrost system is operated by a single control knob which controls and regulates the defrost valve, directing high pressure air through the defrost system

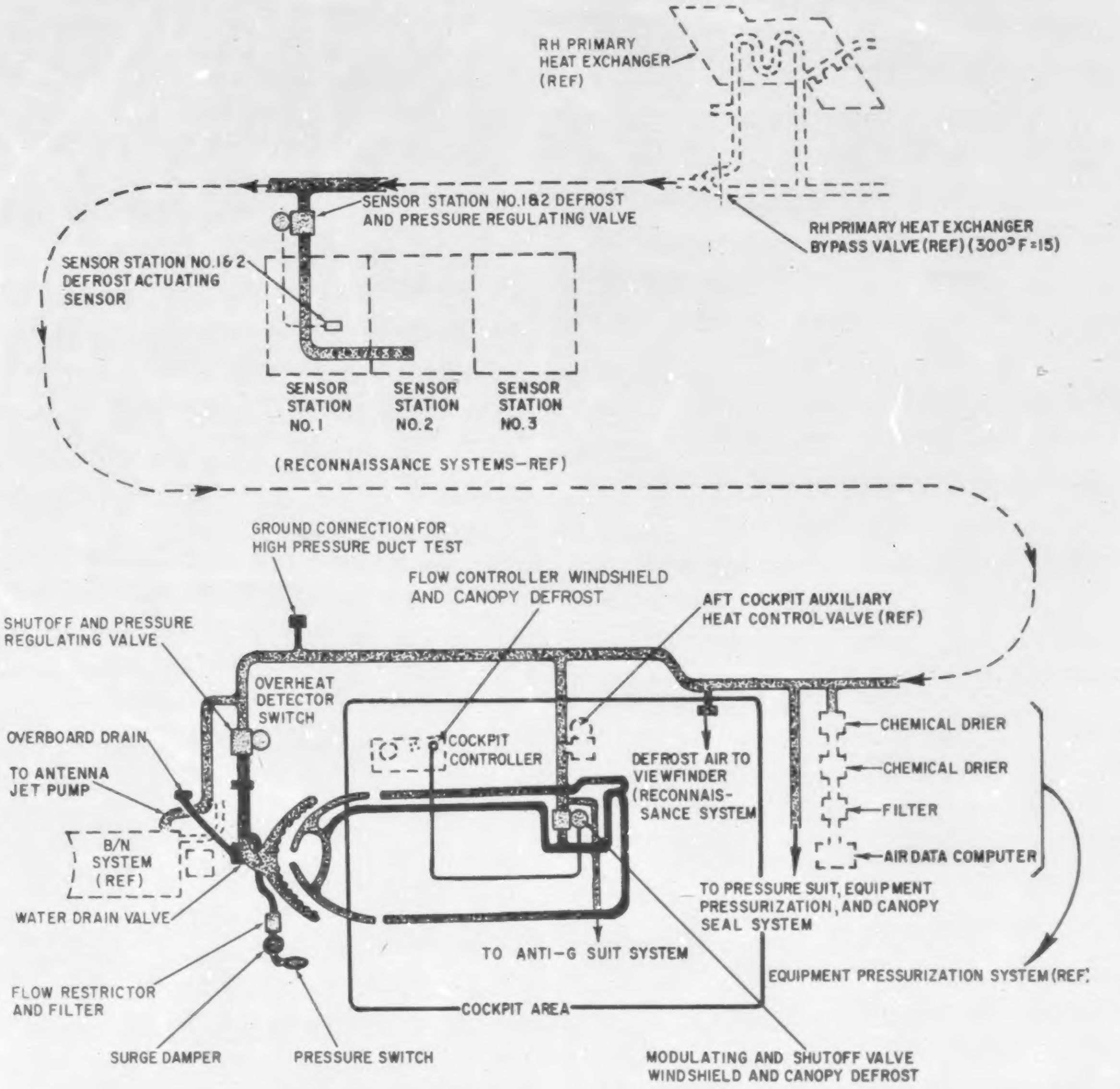

AIR PRESSURE
REGULATOR
TO
CANOPY
SWITCH
CANOPY
SEAL
INFLATED
FROM
REGULATED
EXTERNAL
AIR
SOURCE
AIRFRAME
SEAL VENT
AND GROUND
PRESSURIZATION
CONNECTION
EXTERNALLY REGULATED
AIR PRESSURE
(20 PSI MAXIMUM)

AM.713

Figure 9-12.–Ground inflation of the canopy seal system.

Table 9-2.—Troubleshooting chart for electrically actuated canopy seal system.

Probable cause	Isolation procedure	Remedy
TROUBLE: SEAL WILL NOT INFLATE DURING NORMAL OPERATIONS		
Ruptured seal.	Check the canopy seal by applying an internal air pressure source to the ground test fitting and operating the canopy seal system.	Replace defective seal.
Improperly adjusted or defective canopy latched switch.	Check the adjustment of the canopy latched switch or continuity.	Properly adjust canopy latched switch or replace defective switch.
Defective canopy seal regulator power supply circuit.	Check continuity.	Personnel in the AE rating will repair or replace electrical wire or components as necessary.
Defective canopy seal regulator.	Check continuity.	Replace defective canopy seal regulator.
Canopy seal ground test fitting cap loose or missing.	Check visually.	Tighten or replace the cap.
Canopy seal ground test fitting cap and canopy seal vent fitting reversed.	Check visually.	Reverse fittings.
TROUBLE: SEAL WILL NOT INFLATE DURING GROUND TESTING		
Check valve defective.	Ground test the canopy seal system.	Replace check valve O-rings or replace check valve.
Defective canopy seal regulator.	Check continuity of electrical solenoid. Check canopy seal.	Replace canopy seal regulator.
Ruptured seal.	Check canopy seal.	Replace defective seal.
Defective canopy seal regulator power supply circuit.	Check continuity.	Personnel in the AE rating will repair or replace electrical wire or components as necessary.


RH PRIMARY HEAT EXCHANGER (REF)
SENSOR STATION NO.1&2 DEFROST AND PRESSURE REGULATING VALVE
RH PRIMARY HEAT EXCHANGER BYPASS VALVE (REF) (300° F ±15)
SENSOR STATION NO.1& 2 DEFROST ACTUATING SENSOR
SENSOR STATION NO. 1
SENSOR STATION NO. 2
SENSOR STATION NO. 3
(RECONNAISSANCE SYSTEMS–REF)
GROUND CONNECTION FOR HIGH PRESSURE DUCT TEST
FLOW CONTROLLER WINDSHIELD AND CANOPY DEFROST
AFT COCKPIT AUXILIARY HEAT CONTROL VALVE (REF)
SHUTOFF AND PRESSURE REGULATING VALVE
OVERHEAT DETECTOR SWITCH
OVERBOARD DRAIN
TO ANTENNA JET PUMP
COCKPIT CONTROLLER
DEFROST AIR TO VIEWFINDER (RECONNAISSANCE SYSTEM
CHEMICAL DRIER
CHEMICAL DRIER
FILTER
AIR DATA COMPUTER
B/N SYSTEM (REF)
WATER DRAIN VALVE
TO PRESSURE SUIT, EQUIPMENT PRESSURIZATION, AND CANOPY SEAL SYSTEM
TO ANTI-G SUIT SYSTEM
EQUIPMENT PRESSURIZATION SYSTEM (REF)
FLOW RESTRICTOR AND FILTER
COCKPIT AREA
SURGE DAMPER
PRESSURE SWITCH
MODULATING AND SHUTOFF VALVE WINDSHIELD AND CANOPY DEFROST

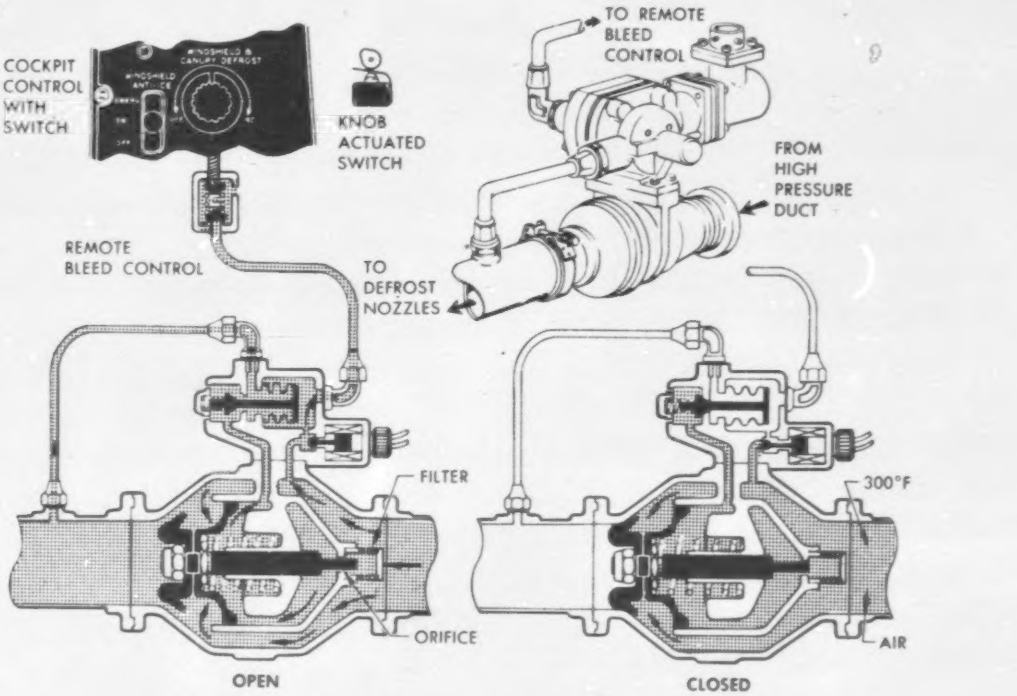
AM.714

Figure 9-13.–Windshield and canopy defrost, anti-ice and rain removal system flow schematic.

ducting to four air outlet ducts, where it is discharged across the inner surface of the windshield and canopy. A canopy latch switch prevents the valve from opening until the forward canopy is closed and locked. This prevents hot air from the canopy defrost system from blowing against the instrument panel of the rear seat. (See fig. 9-13.)

System Components

WINDSHIELD AND CANOPY DEFROST VALVE.–The windshield and canopy defrost valve (fig. 9-14) is a combination pressure regulator and shutoff valve. This valve consists of a variable pressure regulator, a solenoid valve, and a pressure-operated gate valve. When the control knob is initially rotated toward the INC (increase) position, a switch is actuated in the control panel to energize the solenoid of the defrost valve. When the valve solenoid is energized, air is bled from the upstream side of the valve and routed to the regulator piston; the bleed-air pressure built up in the gate valve chamber is routed downstream of the defrost valve, allowing the valve to open. As the control knob is rotated to INC, a mechanical cam is rotated, allowing a greater flow of air from the gate valve chamber, and routing more air pressure downstream in the defrost duct. Rotating the control knob toward OFF decreases the flow of air from the gate valve chamber, reducing the air pressure in the defrost duct. When the control knob is rotated to full OFF, the switch in the control panel is deactuated. In turn, the solenoid is denergized


COCKPIT CONTROL WITH SWITCH
WINDSHIELD & CANOPY DEFROST
WINDSHIELD ANTI-ICE
KNOB ACTUATED SWITCH
TO REMOTE BLEED CONTROL
FROM HIGH PRESSURE DUCT
REMOTE BLEED CONTROL
TO DEFROST NOZZLES
FILTER
300°F
ORIFICE
AIR
OPEN
CLOSED

AM.715

Figure 9-14.—Windshield and canopy defrost valve.

closing the valve. The valve controls the downstream pressure from 5 to 25 psi.

ANTI-ICE AND RAIN REMOVAL SYSTEM

The anti-ice and rain removal system (fig. 9-13) controls windshield icing and removes rain by directing a flow of heated air over the windshield. This heated air serves two purposes—the rapidly moving air breaks the raindrops into small particles which are blown away; the heated air heats the windshield to prevent the moisture that does collect from freezing.

The anti-ice and rain removal system is controlled by the ANTI-ICE switch. This switch has three positions—ON, OFF, and EMERG. When the switch is moved from OFF to the ON position, 28-volt d-c power is transmitted to the anti-ice shutoff and pressure regulating valve solenoid. The energized solenoid causes the valve to open, allowing hot air to be ducted to the windshield anti-ice and rain removal air outlet nozzle. The nozzle directs the high-velocity, heated air over the external surface of the windshield.

Also included in this system is a pressure switch, an overheat switch, and a water drain valve. The pressure switch and the overheat switch protect the system from excessive pressure and heat. The water drain valve drains the moisture from the ducting when the system is not pressurized.

System Components

SHUTOFF AND PRESSURE REGULATOR.—The anti-ice and rain removal shutoff and pressure regulator valve (fig. 9-15) is solenoid activated, pneumatically operated, and serves as the on-off control for the system and regulates the pressure of hot air supplied to the system to 30 psi.

This unit consists of a pressure control chamber, a butterfly gate, spring-loaded piston, and a solenoid valve. When the valve is open, a sampling of down-stream air is routed from the ducting to the control chamber against the backside of the piston face.

This air reflects downstream pressures against the piston face to move it toward the closed position and reduce the pressure of air allowed to pass through the valve. As downstream air pressure is reduced, however, the pressure of downstream air reflected in the control chamber is also reduced, allowing the piston to again move toward the open position. This continuous modulating action will automatically regulate the valve outlet pressure to 30 psi.

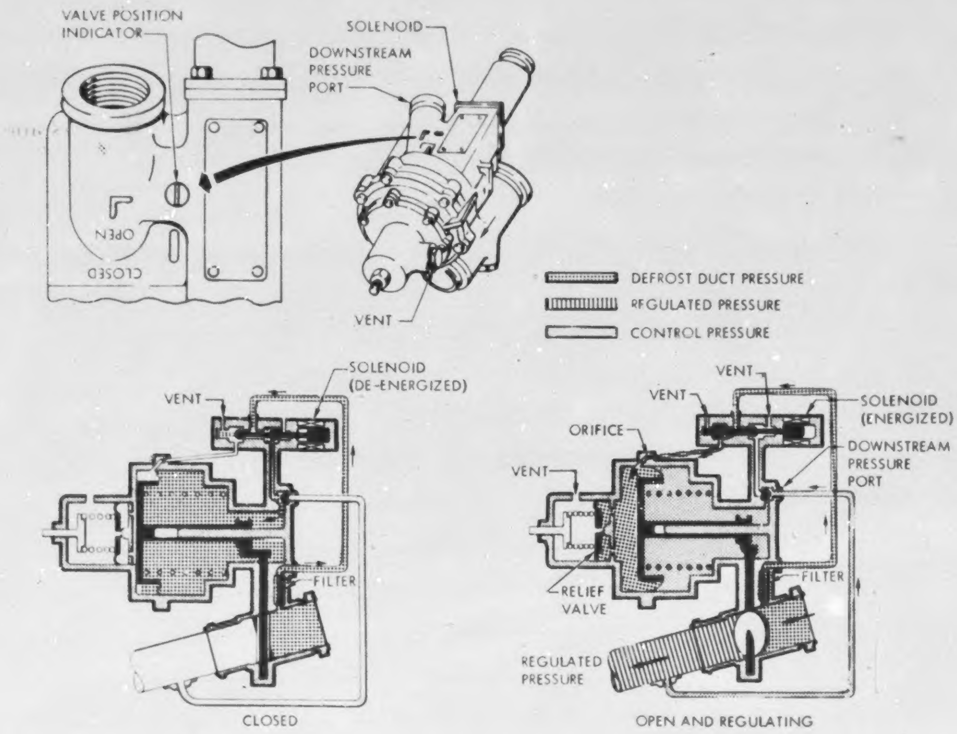
A valve position indicator on the side of the valve may be observed to tell the position of the butterfly gate (open or closed) when the valve is installed in the aircraft.

PRESSURE SWITCH.—The anti-ice and rain removal system pressure switch is shown schematically in figure 9-13. This switch serves as a protective device to prevent the buildup of excessive pressures in the system. The pressure switch consists of a diaphragm and switch assembly. When a pressure of 50 psi is sensed by the diaphragm, it actuates the switch. This action closes the switch contacts and completes a circuit to the solenoid in the WINDSHIELD ANTI-ICE control switch. The energized solenoid moves the control switch to the OFF position, deenergizing the anti-ice and rain removal shutoff valve. The pressure switch will cut out when the pressure is reduced to 40 psi and deenergize the control switch solenoid, allowing the pilot to reposition the control switch to the ON position.

In emergencies when excessive pressure causes the control switch to remain in the OFF position, the pilot may override the overpressure condition by placing the control switch in the EMERG position. In this position, the control switch solenoid has no effect on the switch operation.

To eliminate false actuations of the pressure switch due to pressure surges, a surge damper is placed in the ducting upstream from the pressure switch. (See fig. 9-13.) The surge damper consists of a round chamber containing an inlet and outlet port. The inlet port contains a disc type filter and three restrictor discs.

OVERHEAT DETECTOR SWITCH.—The overheat detector switch protects the system from excessive temperatures by deenergizing the shutoff and pressure regulating valve through an electrical control network. The overheat detector switch consists of a temperature sensing element and a solenoid which actuates a single-


VALVE POSITION INDICATOR
SOLENOID
DOWNSTREAM PRESSURE PORT
OPEN
CLOSED
VENT
DEFROST DUCT PRESSURE
REGULATED PRESSURE
CONTROL PRESSURE
SOLENOID (DE-ENERGIZED)
VENT
FILTER
CLOSED
VENT
VENT
ORIFICE
SOLENOID (ENERGIZED)
DOWNSTREAM PRESSURE PORT
VENT
FILTER
RELIEF VALVE
REGULATED PRESSURE
OPEN AND REGULATING

AM.716

Figure 9-15.—Anti-ice and rain removal shutoff and pressure regulator valve.

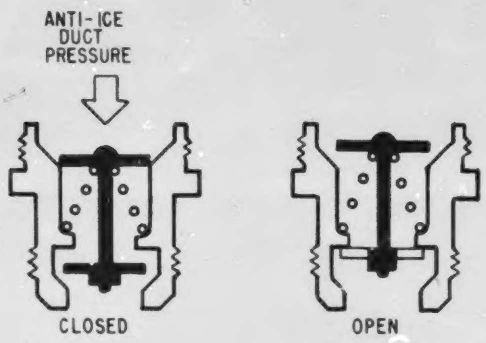
pole, normally open switch. When the temperature in the anti-ice and rain removal duct reaches approximately 350°F, it is detected by the sensing element. The sensing element completes a circuit to the solenoid which causes the switch contacts to close. As the contacts close, a circuit is completed to the windshield anti-ice control switch solenoid, causing the switch to move to the OFF position. When this condition exists, it is necessary to place the control switch in the EMERG position to override the overheat detector switch.

The overheat detector switch is located in the ducting downstream from the anti-ice and rain removal shutoff and pressure regulator valve. (See fig. 9-13.)

WATER DRAIN VALVE.—The anti-icing and rain removal system water drain valve allows water to escape from the anti-ice and rain removal outlet nozzle when the system is inoperative. The unit contains a poppet valve which is spring loaded to the open position when the system is depressurized. The valve will close when a maximum differential of 4 psi between atmospheric pressure and anti-ice duct pressure exists. The valve will vent open with a minimum pressure differential across the valve of 1 psi. Figure 9-16 shows a cross sectional view of this valve.

SYSTEM MAINTENANCE

General maintenance for the windshield and canopy defrost and anti-ice and rain removal systems includes servicing the system, removing and installing major system components, making



AM.717

Figure 9-16.–Anti-ice and rain removal system water drain valve.

applicable tests and operational checks, and troubleshooting for isolation and correction of malfunctions within the system.

The importance of proper and careful installation during defrost and anti-ice system maintenance cannot be overemphasized. The high pressure of the supply air for these systems will cause poorly installed components and ducting to leak much faster than they would in systems with lower pressures. If a large leak occurs, the extremely high temperature of the air used in these systems can cause structural damage to the aircraft.

Care should be exercised during maintenance procedures to keep the system components and ducting free from grease and oils, dirt, or foreign materials. Such materials can coat the windshield and canopy during operation of the system and obscure vision.

The applicable Maintenance Instructions Manual contains the information necessary for maintaining these systems. It furnishes such information as proper procedures, manpower requirements, materials lists, tools and equipment lists, quality assurance instructions, and maintenance level instructions for disposition of defective components. The Maintenance Instructions Manual also contains a troubleshooting chart to aid in isolating system malfunctions.

Servicing

Servicing of the windshield and canopy defrosting, anti-ice, and rain removal system is limited to servicing the surge damper filter and periodic inspections for visible defects and dirt or foreign material accumulations. Most major components used in these systems are self-sustaining and require no general servicing between overhaul periods for normal operation.

The surge damper used in the anti-ice and rain removal system is serviced by periodic removal for cleaning and replacement of the filter.

Operational Checks

There are many different operational checks specified by the various aircraft manufacturers. The general operational check of the complete system and the high pressure duct test are two of the checks usually specified.

The general operational check is a complete functional check of the system. This check is accomplished using the aircraft engines to furnish air pressure and electric power to operate the system under as near flight conditions as possible. The valves and controls in the system should be checked in accordance with the instructions found in the applicable aircraft Maintenance Instructions Manual.

The high pressure duct test is a test designed to check the ducting system for air leaks between the engine bleed line check valves and the system shutoff valves. This test should be performed any time a joint in the high pressure duct system has been broken. The aircraft Maintenance Instructions Manual will specify the tools, equipment, and information necessary to perform this test.

When performing the high pressure duct test, each joint in the system should be checked for leaks. This should be done by applying a leak test solution (MIL-L-25567) to each joint while the system is under pressure. Air leakage of small magnitude which results in the formation of bubbles, but not capable of blowing "open air" passages through the bubble formation, is generally acceptable. Larger air leaks of enough magnitude to prevent the formation of bubbles or to blow "open air" through a bubble formation are NOT acceptable.

After performing this high pressure duct test, the system should be given a thorough inspection and an operational check to insure that all plugs and caps were removed and all lines were properly connected.

Troubleshooting

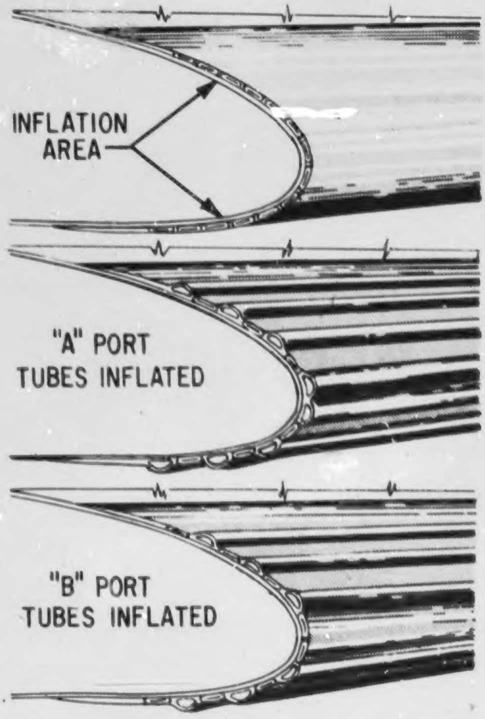
Troubleshooting or fault isolation is a systematic method of determining the cause of a system malfunction. This is normally accomplished by studying the system diagrams (system flow schematics and electrical diagrams) and the troubleshooting charts furnished by the aircraft manufacturer in the applicable Maintenance Instructions Manual.

The troubleshooting charts supply the cause, isolation procedure, and the remedy for some of the more common malfunctions which cause the windshield and canopy defrost, anti-ice, and rain removal systems to become inoperative or uncontrollable. These charts are organized in a definite sequence under each possible trouble, according to the probability of failure and ease of investigation. In order to obtain maximum value from these charts, they should be used systematically in accordance with the aircraft manufacturer's recommendations.

DEICER SYSTEMS

The formation of ice on the leading edges of aircraft surfaces presents a serious problem for aircraft operating at low temperatures. Besides adding unnecessary weight to the aircraft, ice formations change the airfoil characteristics of a surface, thus creating serious flight hazards. One method of removing ice formations is by the use of deicer boots. Deicer boots are used in removing ice formations from the leading edges of wings and tail surfaces, and in some instances, antenna masts.

The deicing system operates by means of compressed air supplied by engine-driven pumps or by compressed bleed air from jet engines. Each deicer boot contains a number of inflatable cells. These cells are inflated and deflated alternately, causing a wavelike motion which cracks the ice that has formed. (See fig. 9-17.) Once the ice has been cracked, the airstream peels it back and carries it away.

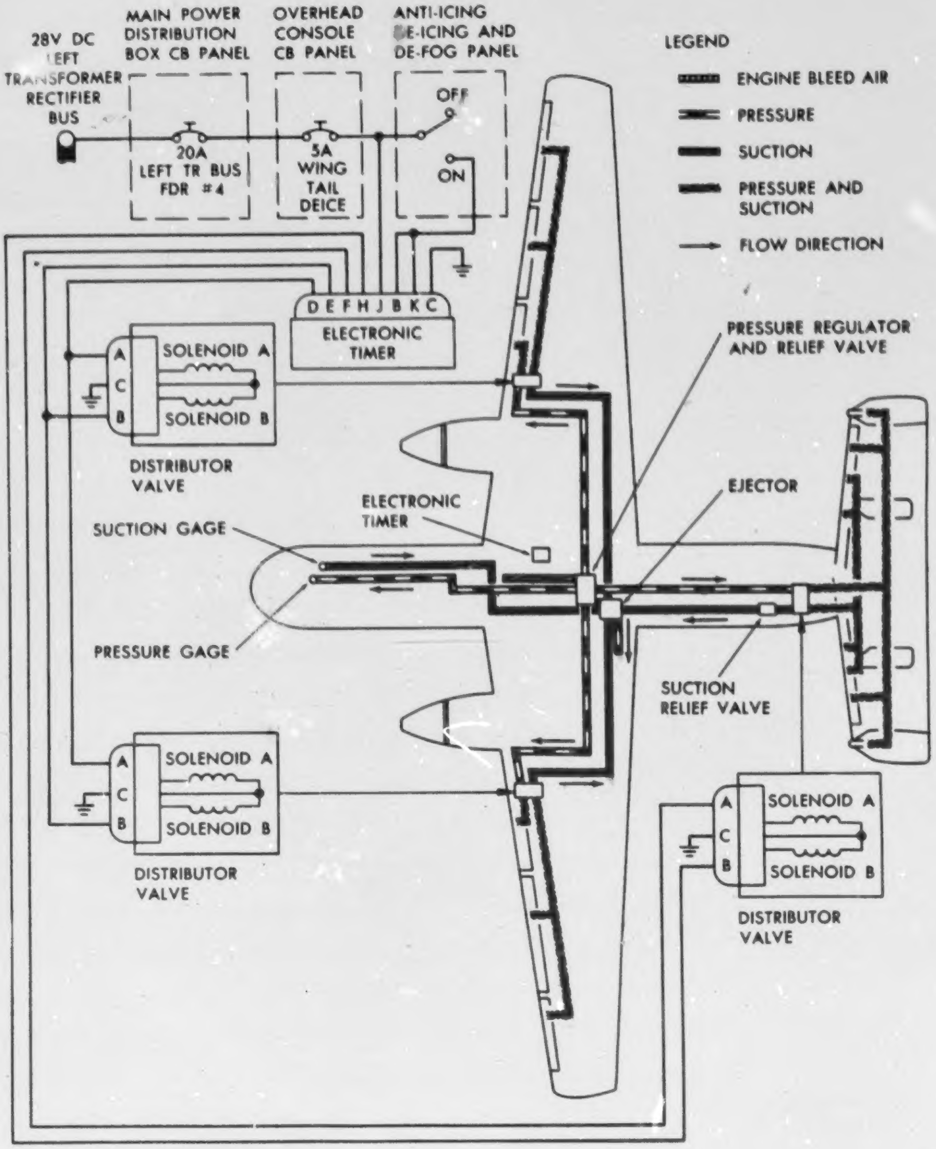


AM.642

Figure 9-17.—Deicer boot operation.

DESCRIPTION

The E-2A aircraft deicing system, illustrated in figure 9-18, is supplied by engine bleed-air pressure. This system is pneumatically operated and electrically controlled. It removes accumulated ice from the leading edges of the wings, stabilizers, and fins by inflating and deflating its deicer boots bonded to the leading edges. To do this systematically, an electronic timer is energized through a two-position WING TAIL toggle switch to control three distributor valves that apply 18 psi air pressure to inflate the boots and 6 inches Hg to deflate the boots at regulated intervals.


28V DC LEFT TRANSFORMER RECTIFIER BUS
MAIN POWER DISTRIBUTION BOX CB PANEL
20A LEFT TR BUS FDR #4
OVERHEAD CONSOLE CB PANEL
5A WING TAIL DEICE
ANTI-ICING DE-ICING AND DE-FOG PANEL
OFF
ON
LEGEND
ENGINE BLEED AIR
PRESSURE
SUCTION
PRESSURE AND SUCTION
FLOW DIRECTION
D E F H J B K C
ELECTRONIC TIMER
A
C
B
SOLENOID A
SOLENOID B
DISTRIBUTOR VALVE
PRESSURE REGULATOR AND RELIEF VALVE
EJECTOR
ELECTRONIC TIMER
SUCTION GAGE
PRESSURE GAGE
SUCTION RELIEF VALVE
A
C
B
SOLENOID A
SOLENOID B
DISTRIBUTOR VALVE
A
C
B
SOLENOID A
SOLENOID B
DISTRIBUTOR VALVE

AM.661

Figure 9-18.—E-2A deicing system schematic.

The engine bleed-air pressure to the system is supplied and regulated by the pressure regulator and relief valve. Suction provided by an ejector is regulated by the suction relief valve. Both the pressure and suction applied through the system tubing and components are indicated by gages installed in the cockpit.

The main components of the deicing system are as follows: electronic timer, distributor valves, pressure regulator and relief valve, ejector, suction relief valve, deicer boots, and the pressure and suction gages.

Further information on the components of the E-2A deicing system is provided in Aviation Structural Mechanic E 3 & 2, NAVTRA 10309-C, Chapter 6.

OPERATION

When the WING TAIL deicer switch is selected to the ON position, the electronic timer is energized by a 28-volt d-c power supply. In turn, the electronic timer energizes the distributor valves in sequence to apply air pressure and then suction to the deicer boots. Pressure is supplied from (and regulated by) the pressure regulator and relief valve; suction is supplied from the ejector and regulated by the suction relief valve.

Each group of boots is inflated and deflated in sequence–the inboard wing boots, the outboard wing boots, the outboard stabilizer and outboard fin boots, and the inboard stabilizer and inboard fin boots. Each group is inflated for approximately 5 seconds; approximately 10 seconds after deflation starts, the succeeding group starts to inflate. The total time to complete the inflation cycle for the four groups is approximately 60 seconds. At the completion of the inflation period of each group of boots, the electronic timer energizes the distributor valves to remove air from the boots. At the beginning of each inflation and deflation period, the pressure and suction gages indicate a momentary drop in pressure and suction, respectively. These fluctuations indicate normal system operation.

MAINTENANCE

Maintenance of the deicing system is normally performed by personnel of the AME, AMS, and AE ratings. The AME is generally responsible for the operation of deicing systems; consequently, his duties include such tasks as troubleshooting and general maintenance functions of these systems. Personnel of the AMS rating are usually concerned with the replacement and upkeep of the deicer boots, while personnel of the AE rating are concerned with the removal and replacement of electrical units within the deicing system.

Operational Check

The deicing operational check performed on the E-2A aircraft requires two men and the specified ground support equipment. Like other types of operational checks, the deicing system check is conducted by a step-by-step method. If trouble occurs during the procedure, it must be corrected before proceeding to the next step. Prior to performing the deicing operational check, insure that all unnecessary switches are in the OFF position. Then connect the external electrical power to the aircraft and engage the necessary deicing system circuit breakers. In addition, connect an external air supply, 50 to 90 psi, to the bleed-air-line test connection. The deicer boot will be deflated.

The AME positions the WING TAIL switch to the ON position. After approximately 20 seconds of electronic timer warmup, the deicer boots should inflate and deflate in a definite sequence–the inboard wing boots, the outboard wing boots, the outboard stabilizer and fin boots, and the inboard stabilizer and fin boots, in that order. Each set of boots is inflated for approximately 5 seconds and then the next set of boots, as outlined in the preceding sequence, is inflated approximately 10 seconds from the time the preceding set started to inflate.

For a specific operational check of a deicing system, the AME must consult the applicable aircraft Maintenance Instructions Manual.

ANTI-ICING SYSTEMS

An anti-icing system is designed to prevent ice from forming on the aircraft, whereas a deicing system, as previously discussed, is designed to remove ice after it has formed. Aircraft anti-icing systems are designed to prevent ice from forming in/on carburetors and pitot tubes, or on propellers and the leading edges of wings and stabilizers. These systems may use electrical heaters, hot air, or a combination of both as the means to prevent ice formation. The AME is primarily concerned with the hotair anti-icing system which prevents the formation of ice on both wings and stabilizers.

The P-3A wing anti-icing system is a hot wing type, utilizing hot compressed bleed air from the engines. A detailed description of the system components and their operation is presented in Aviation Structural Mechanic E 3 & 2, NavTra 10309-C, chapter 6.

MAINTENANCE

Maintenance of the anti-icing system for the AME1 and AMEC normally consists of troubleshooting. Troubleshooting is a step-by-step method whereby the AME may deduce the cause of a particular malfunction. For the AME, troubleshooting is one of his most important responsibilities.

In order to troubleshoot intelligently, the AME must be familiar with the system at hand. In addition, he must know the function of each component in the system and have a mental picture of the location of each component in relation to other components in the system. This can be best achieved by studying the schematic diagrams of the system.

Also, as an aid to the AME the aircraft manufacturer furnishes troubleshooting charts which give a recommended procedure to follow during troubleshooting. Figure 9-19 illustrates an anti-icing system overheat warning troubleshooting chart. This chart lists the most probable causes first and branches off to the next most probable, etc. By following the recommended charts and procedures, many valuable maintenance hours can be saved.

Maintenance Documentation (AIMD)

Normally the AME1 and AMEC have a one point contact with the supporting supply activity. If assigned to an AIMD your job would be as production supervisor. One of the responsibilities of this position would be the knowledge of what occurs during the processing and flow of the MAF for components inducted for repairs. The following paragraphs briefly cover this documentation. More detailed information can be found in Volume 2, of the Naval Aviation Maintenance Program, (NAMP) OPNAV INST. 4790.2.

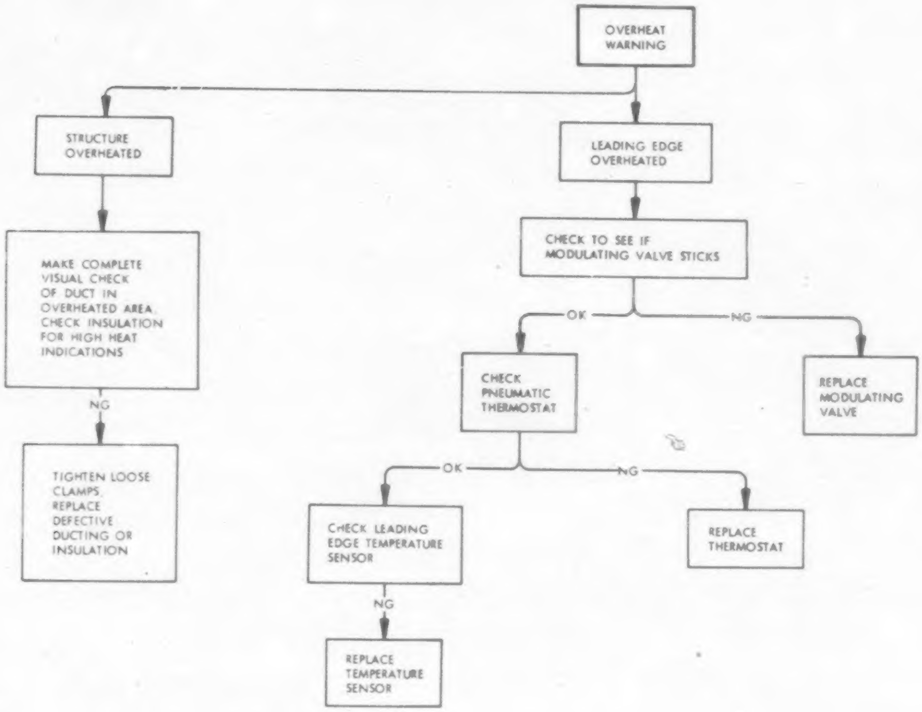
After replacement of an RFI component on an aircraft by the OMA activity the non-RFI component is turned over to the Material Delivery Unit (MDU) along with copies 2, 3, and 4 of the multicopy MAF and applicable logs and records. Copy one (figure 9-20(A)) is forwarded to data processing by the OMA activity.

The MDU delivers the component and the remaining three copies of the MAF to the Administrative Screening Unit (AMSU) of the AIMD material control work center. The yellow copy (figure 9-20(B)) is filled in by AMSU.

Upon completion of screening the component and it has been determined that the AIMD has repair capabilities, the AMSU enters the Julian date received in data block 30.2 and the production control number (PCN), work priority, and dates due in and out of AIMD. This information is carboned through the remaining two copies of the MAF when inserted in data block H. The yellow copy is then forwarded to the Component Control Section (CCS) and the remaining copies (green and buff) are delivered with the component to the applicable work center, when directed.

The yellow copy of the MAF is filed by the Document Control Unit of the CCS in the induction return due file. When the component is returned from the AIMD the DCU personnel remove the yellow copy from the file and make the following entries:

1. Block 60.1. Organizational code of the AIMD.
2. Block 60.2. This block was filled in when DCU initially filed the copy.
3. Block 60.3. Fill in the proper SMIC (special material identification code).


OVERHEAT WARNING
STRUCTURE OVERHEATED
LEADING EDGE OVERHEATED
MAKE COMPLETE VISUAL CHECK OF DUCT IN OVERHEATED AREA. CHECK INSULATION FOR HIGH HEAT INDICATIONS
CHECK TO SEE IF MODULATING VALVE STICKS
OK
NG
CHECK PNEUMATIC THERMOSTAT
REPLACE MODULATING VALVE
NG
TIGHTEN LOOSE CLAMPS. REPLACE DEFECTIVE DUCTING OR INSULATION
OK
NG
CHECK LEADING EDGE TEMPERATURE SENSOR
REPLACE THERMOSTAT
NG
REPLACE TEMPERATURE SENSOR

AM.633

Figure 9-19.—Anti-icing troubleshooting chart.

4. Block 60.4. Fill in unit of issue.

5. Block 60.5. Fill in the quantity turned in.

6. Block 60.A. Fill in the Julian date on which block 60 was filled in.

7. Block 60.6. Fill in the cognizance symbol of the item turned in.

8. Block 60.7. Fill in the purpose code in which the item is returned to. (i.e., W for pool, A for nonpool.)

9. Block 60.8. Fill in the condition code of the item. (i.e., A for RFI; F for non-RFI—to be returned to the DOP; H for scrap; and N for long supply.)

10. Block 60.9. This block contains the MCC (material condition code) of the item.

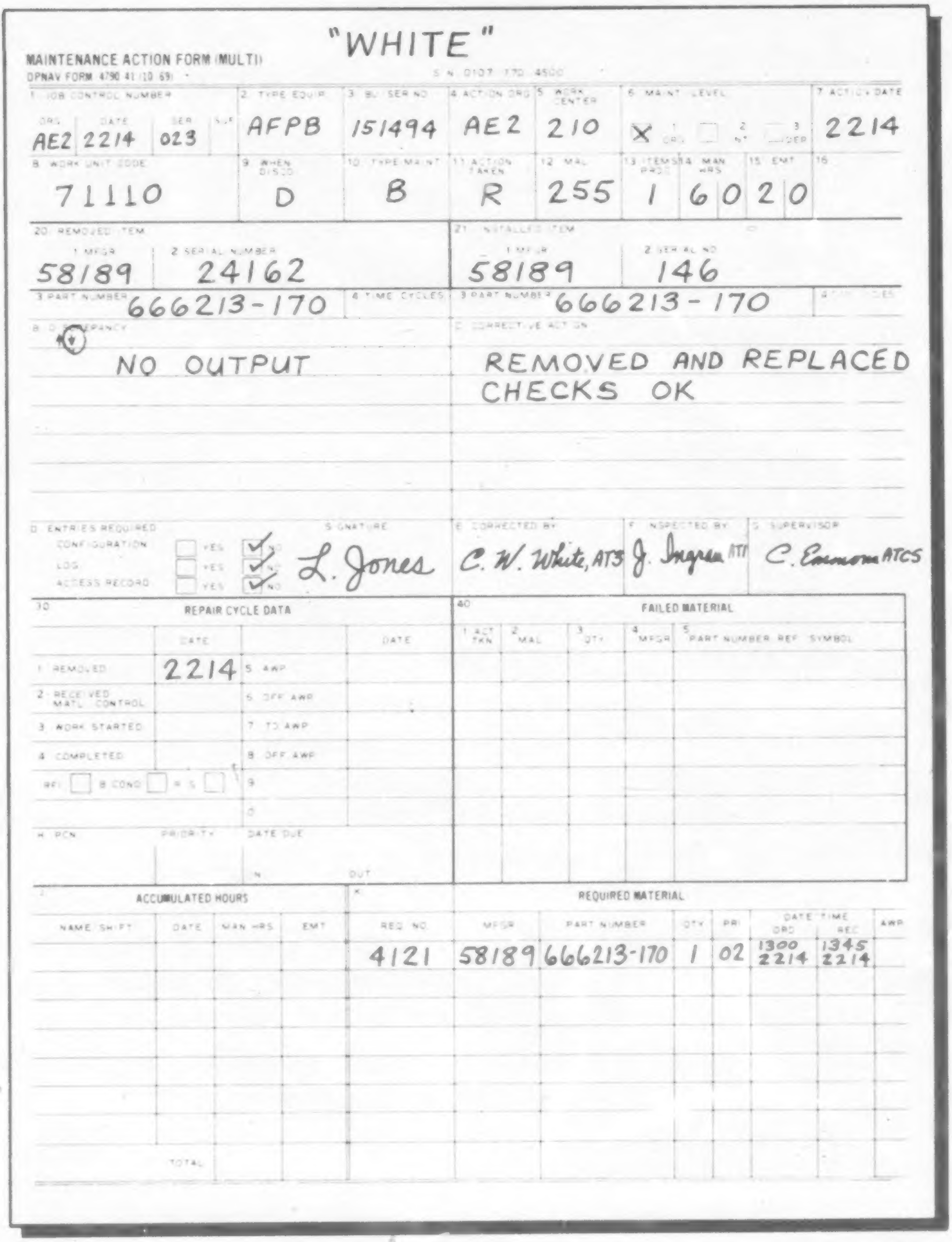
11. Block 60.10. This block is left blank.

12. Block 60.11. This block contains card code 61 for RFI items and card code 63 for all items returned from AIMD as non-RFI.

DISTRIBUTION.—After block 60 is filled in, the yellow copy MAF is forwarded to data processing for collection of maintenance and material data from the supply standpoint.

Copy #3, the green copy (fig. 9-20(C)), is the AIMD copy. Any action taken by AIMD on the component is reported on this copy of the MAF.

In addition to the information carboned through from previous entries made on the white and yellow copies, AIMD makes several entries directly on copy three. In the following paragraphs is a description of the entries made by (1) production control upon induction of the component, (2) those made by the work center



"WHITE"

MAINTENANCE ACTION FORM (MULTI)
OPNAV FORM 4790 41 (10 69)
S N 0107 770 4500

1. JOB CONTROL NUMBER ORG AE2 · DATE 2214 · SER 023 · SUF	2. TYPE EQUIP AFPB	3. BU SER NO 151494	4. ACTION ORG AE2	5. WORK CENTER 210	6. MAINT LEVEL ☒ 1 ORG ☐ 2 INT ☐ 3 DEPOT	7. ACTION DATE 2214
8. WORK UNIT CODE 71110	9. WHEN DISCO D	10. TYPE MAINT B	11. ACTION TAKEN R	12. MAL 255	13. ITEMS PROC 1 · 14. MAN HRS 6 0 · 15. EMT 2 0	16.

20. REMOVED ITEM
1 MFGR 58189 · 2 SERIAL NUMBER 24162
3 PART NUMBER 666213-170 · 4 TIME CYCLES

21. INSTALLED ITEM
1 MFGR 58189 · 2 SERIAL NO 146
3 PART NUMBER 666213-170 · 4 TIME CYCLES

B. DISCREPANCY
NO OUTPUT

C. CORRECTIVE ACTION
REMOVED AND REPLACED
CHECKS OK

D. ENTRIES REQUIRED
CONFIGURATION ☐ YES ☑ NO
LOG ☐ YES ☑ NO
ACCESS RECORD ☐ YES ☑ NO
SIGNATURE L. Jones

E. CORRECTED BY C. W. White, AT3
F. INSPECTED BY J. Ingram AT1
G. SUPERVISOR C. Emmons ATCS

30 REPAIR CYCLE DATA

	DATE		DATE
1 REMOVED	2214	5 AWP	
2 RECEIVED MATL CONTROL		6 OFF AWP	
3 WORK STARTED		7 TO AWP	
4 COMPLETED		8 OFF AWP	
RFI ☐ B COND ☐ R S ☐		9	
		0	

H. PCN · PRIORITY · DATE DUE IN · OUT

40 FAILED MATERIAL

1 ACT TKN	2 MAL	3 QTY	4 MFGR	5 PART NUMBER REF SYMBOL

J. ACCUMULATED HOURS

NAME SHIFT	DATE	MAN HRS	EMT
TOTAL			

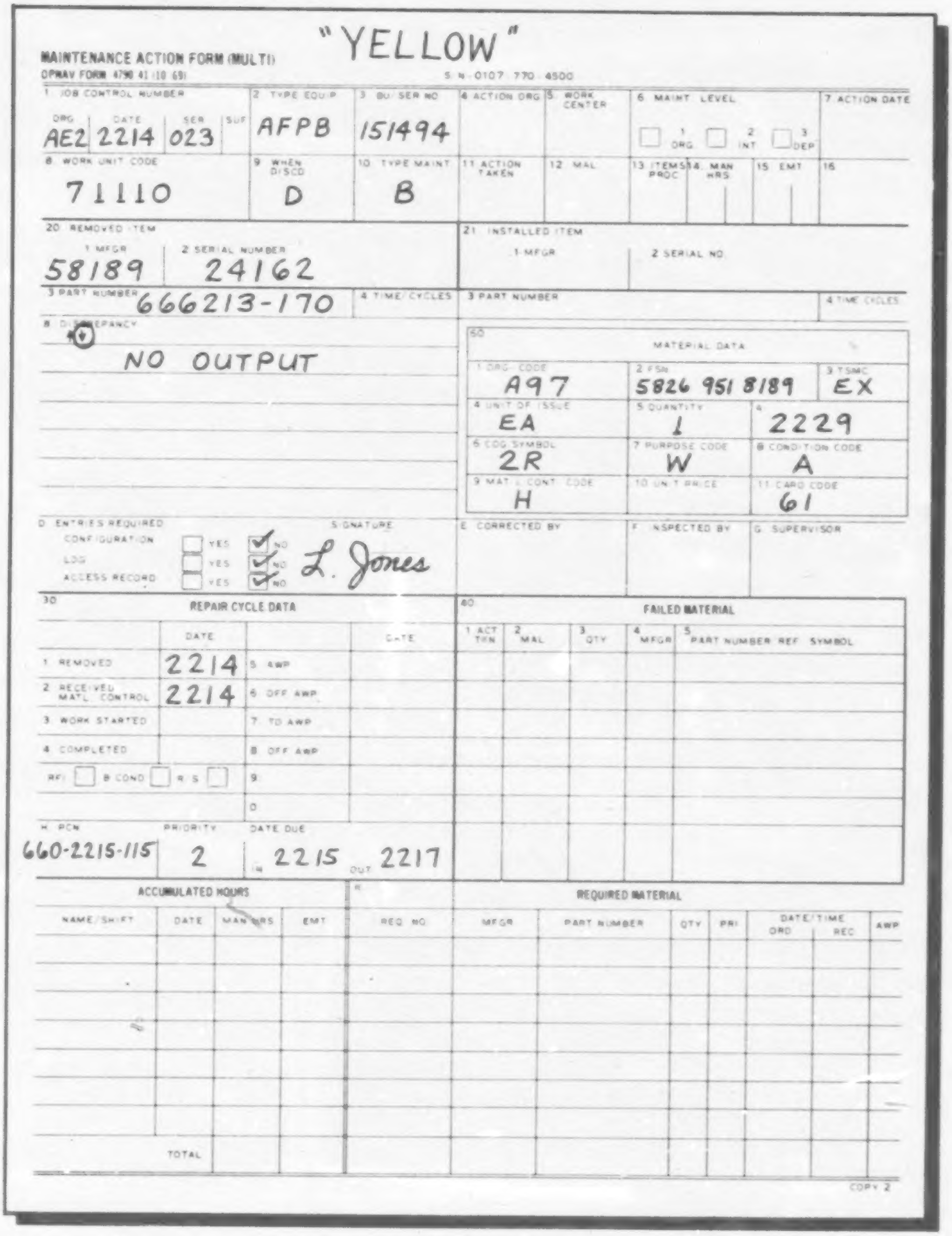
K. REQUIRED MATERIAL

REQ NO	MFGR	PART NUMBER	QTY	PRI	DATE TIME ORD	DATE TIME REC	AWP
4121	58189	666213-170	1	02	1300 2214	1345 2214	

(A)

AK.446

Figure 9-20.–Multicopy MAF.



"YELLOW"

MAINTENANCE ACTION FORM (MULTI)
OPNAV FORM 4790 41 (10 69)
S N 0107 770 4500

1 JOB CONTROL NUMBER ORG AE2 DATE 2214 SER 023 SUF	2 TYPE EQUIP AFPB	3 BU SER NO 151494	4 ACTION ORG	5 WORK CENTER	6 MAINT LEVEL ☐ 1 ORG ☐ 2 INT ☐ 3 DEP	7 ACTION DATE
8 WORK UNIT CODE 71110	9 WHEN DISCD D	10 TYPE MAINT B	11 ACTION TAKEN	12 MAL	13 ITEMS PROC 14 MAN HRS 15 EMT	16

20 REMOVED ITEM
1 MFGR 58189
2 SERIAL NUMBER 24162
3 PART NUMBER 666213-170
4 TIME/CYCLES

21 INSTALLED ITEM
1 MFGR
2 SERIAL NO
3 PART NUMBER
4 TIME CYCLES

8 DISCREPANCY
NO OUTPUT

50 MATERIAL DATA

1 ORG CODE A97	2 FSN 5826 951 8189	3 TSMC EX
4 UNIT OF ISSUE EA	5 QUANTITY 1	4 2229
6 COG SYMBOL 2R	7 PURPOSE CODE W	8 CONDITION CODE A
9 MAT L CONT CODE H	10 UNIT PRICE	11 CARD CODE 61

D ENTRIES REQUIRED
CONFIGURATION ☐ YES ☑ NO
LOG ☐ YES ☑ NO
ACCESS RECORD ☐ YES ☑ NO
SIGNATURE L. Jones

E CORRECTED BY
F INSPECTED BY
G SUPERVISOR

30 REPAIR CYCLE DATA

	DATE		DATE
1 REMOVED	2214	5 AWP	
2 RECEIVED MATL CONTROL	2214	6 OFF AWP	
3 WORK STARTED		7 TO AWP	
4 COMPLETED		8 OFF AWP	
RFI ☐ B COND ☐ R S ☐		9	
		0	

H PCN 660-2215-115
PRIORITY 2
DATE DUE IN 2215 OUT 2217

40 FAILED MATERIAL

1 ACT TKN	2 MAL	3 QTY	4 MFGR	5 PART NUMBER REF SYMBOL

ACCUMULATED HOURS

NAME/SHIFT	DATE	MAN HRS	EMT
TOTAL			

R REQUIRED MATERIAL

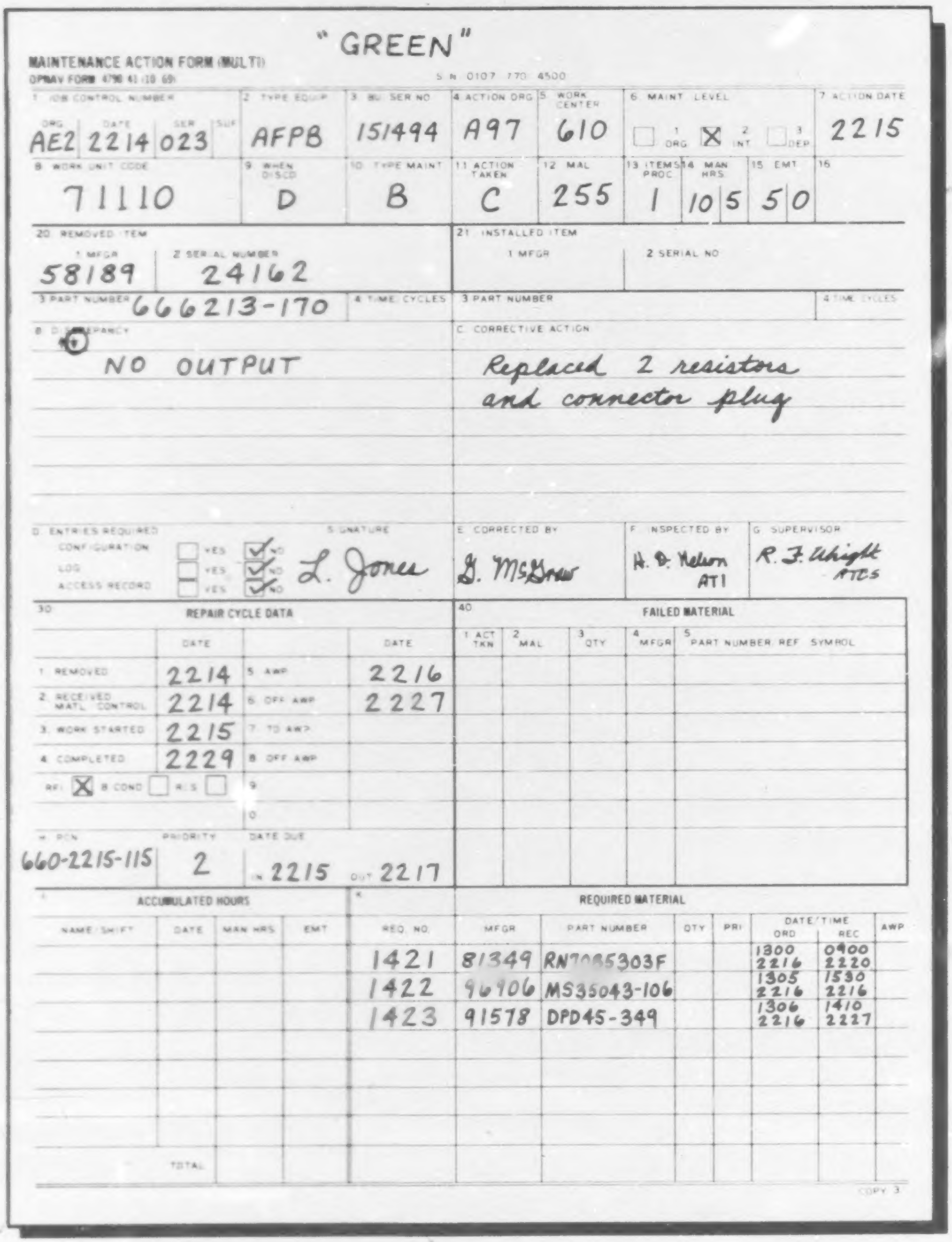
REQ NO	MFGR	PART NUMBER	QTY	PRI	DATE/TIME ORD	DATE/TIME REC	AWP

COPY 2

(B)

Figure 9-20.—Multicopy MAF—Continued.

AK.447



"GREEN"

MAINTENANCE ACTION FORM (MULTI)
OPNAV FORM 4790 41 (10 69)
S N 0107 770 4500

1. JOB CONTROL NUMBER ORG AE2 DATE 2214 SER 023 SUF	2. TYPE EQUIP AFPB	3. BU SER NO 151494	4. ACTION ORG A97	5. WORK CENTER 610	6. MAINT LEVEL ☐ 1 ORG ☒ 2 INT ☐ 3 DEP	7. ACTION DATE 2215
8. WORK UNIT CODE 71110	9. WHEN DISCD D	10. TYPE MAINT B	11. ACTION TAKEN C	12. MAL 255	13. ITEMS PROC 1 14. MAN HRS 10 5 15. EMT 5 0	16

20. REMOVED ITEM
1 MFGR 58189
2 SERIAL NUMBER 24162
3 PART NUMBER 666213-170
4 TIME CYCLES

21. INSTALLED ITEM
1 MFGR
2 SERIAL NO
3 PART NUMBER
4 TIME CYCLES

B. DISCREPANCY
NO OUTPUT

C. CORRECTIVE ACTION
Replaced 2 resistors
and connector plug

D. ENTRIES REQUIRED
CONFIGURATION ☐ YES ☑ NO
LOG ☐ YES ☑ NO
ACCESS RECORD ☐ YES ☑ NO
SIGNATURE L. Jones

E. CORRECTED BY G. McGraw

F. INSPECTED BY H. D. Nelson AT1

G. SUPERVISOR R. F. Wright ATCS

30. REPAIR CYCLE DATA

	DATE		DATE
1. REMOVED	2214	5. AWP	2216
2. RECEIVED MATL CONTROL	2214	6. OFF AWP	2227
3. WORK STARTED	2215	7. TO AWP	
4. COMPLETED	2229	8. OFF AWP	
RFI ☒ B COND ☐ R/S ☐		9	
		0	

H. PCN 660-2215-115
PRIORITY 2
DATE DUE IN 2215 OUT 2217

40. FAILED MATERIAL

1 ACT TKN	2 MAL	3 QTY	4 MFGR	5 PART NUMBER REF SYMBOL

J. ACCUMULATED HOURS

NAME/SHIFT	DATE	MAN HRS	EMT
TOTAL			

K. REQUIRED MATERIAL

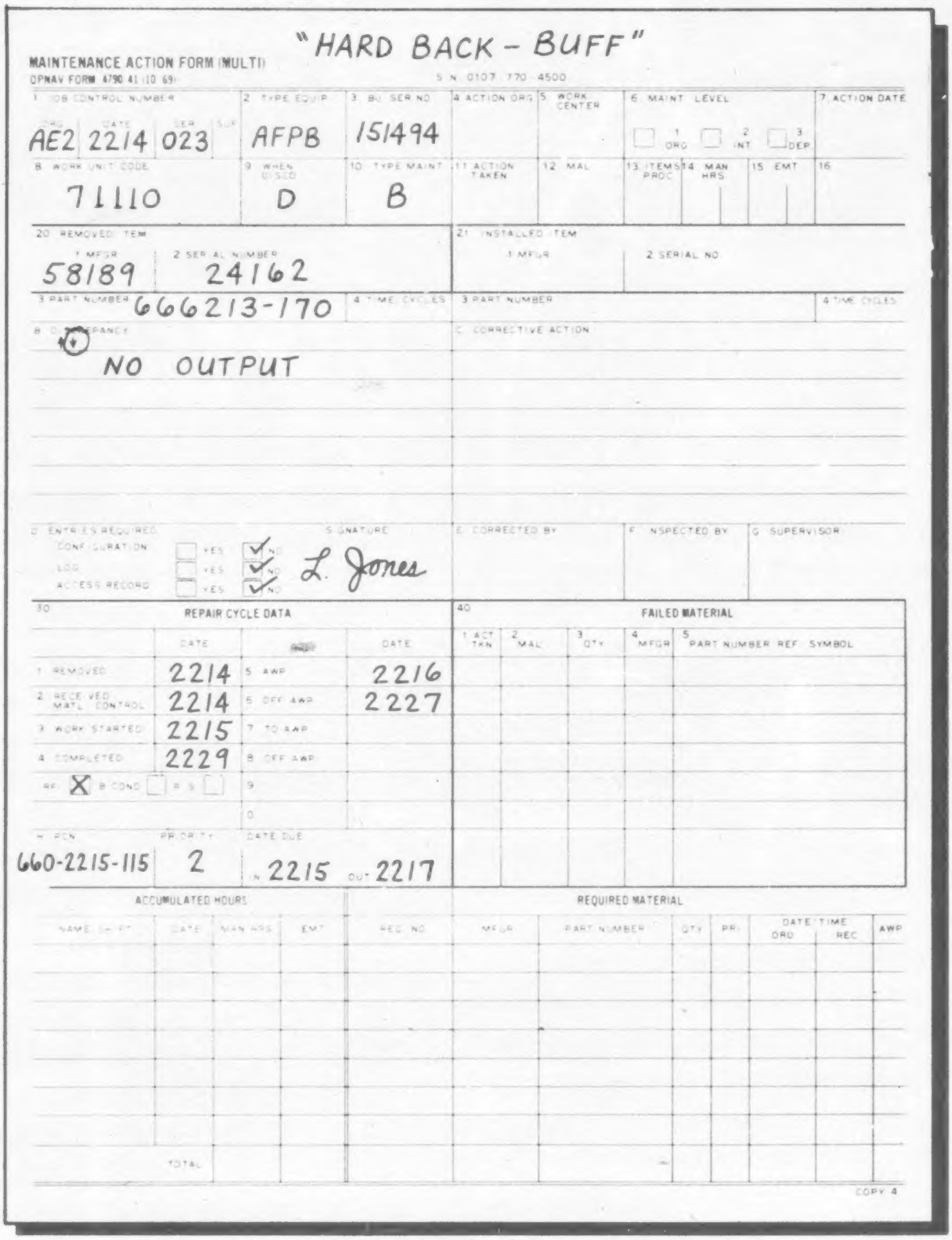
REQ. NO.	MFGR	PART NUMBER	QTY	PRI	DATE/TIME ORD	DATE/TIME REC	AWP
1421	81349	RN7085303F			1300 2216	0900 2220	
1422	96906	MS35043-106			1305 2216	1530 2216	
1423	91578	DPD45-349			1306 2216	1410 2227	

COPY 3

(C)

AK.448

Figure 9-20.–Multicopy MAF–Continued.



"HARD BACK - BUFF"

MAINTENANCE ACTION FORM (MULTI)
OPNAV FORM 4790 41 (10 69)
S N 0107 770 4500

1 JOB CONTROL NUMBER ORG AE2 · DATE 2214 · SER 023 · SUF	2 TYPE EQUIP AFPB	3 BU SER NO 151494	4 ACTION ORG	5 WORK CENTER	6 MAINT LEVEL ☐ 1 ORG ☐ 2 INT ☐ 3 DEP	7 ACTION DATE
8 WORK UNIT CODE 71110	9 WHEN DISCD D	10 TYPE MAINT B	11 ACTION TAKEN	12 MAL	13 ITEMS PROC · 14 MAN HRS · 15 EMT	16

20 REMOVED ITEM
1 MFGR 58189
2 SERIAL NUMBER 24162
3 PART NUMBER 666213-170
4 TIME CYCLES

21 INSTALLED ITEM
1 MFGR
2 SERIAL NO
3 PART NUMBER
4 TIME CYCLES

B DISCREPANCY
NO OUTPUT

C CORRECTIVE ACTION

D ENTRIES REQUIRED
CONFIGURATION ☐ YES ☑ NO
LOG ☐ YES ☑ NO
ACCESS RECORD ☐ YES ☑ NO

SIGNATURE L. Jones

E CORRECTED BY
F INSPECTED BY
G SUPERVISOR

30 REPAIR CYCLE DATA

	DATE		DATE
1 REMOVED	2214	5 AWP	2216
2 RECEIVED MATL CONTROL	2214	6 OFF AWP	2227
3 WORK STARTED	2215	7 TO AWP	
4 COMPLETED	2229	8 OFF AWP	
RFI ☒ B COND ☐ R S ☐		9	
		0	

H PCN 660-2215-115
PRIORITY 2
DATE DUE IN 2215 OUT 2217

40 FAILED MATERIAL

1 ACT TKN	2 MAL	3 QTY	4 MFGR	5 PART NUMBER REF SYMBOL

ACCUMULATED HOURS

NAME SHIFT	DATE	MAN HRS	EMT
TOTAL			

REQUIRED MATERIAL

REQ NO	MFGR	PART NUMBER	QTY	PRI	DATE/TIME ORD	DATE/TIME REC	AWP

COPY 4

(D)

AK.449

Figure 9-20.—Multicopy MAF—Continued.

that performs the repair action, (3) those entries made when the part goes into an awaiting parts (AWP) status, (4) those made when it comes out of AWP, and (5) entries made when action on the item is completed by the AIMD.

ENTRIES MADE BY PRODUCTION CONTROL UPON INDUCTION.–When the item is sent to the applicable work center for repair, production control enters that Julian date in data block 30.3. This entry carbons through to the copy 4. They also insert the current Julian date in data block 7, which does not carbon through.

ENTRIES MADE BY THE WORK CENTER UPON RECEIPT OF THE COMPONENT.–When the work center that is going to repair the item receives it and the number 3 and 4 copies of the MAF, its personnel fill in blocks 4, 5, and 6. These entries are mentioned here to show that they are different from the entries made in the same blocks on the "white" copy.

ENTRIES MADE WHEN A COMPONENT GOES AWP.–Many occasions will arise when repair parts are required for the part undergoing repair. When this situation occurs, the applicable work center initiates action to order the items, and logs this data in Block K. It also makes a Julian date entry in data block 30.5 as to the date the component went into AWP status. The entry in block K does not carbon through but the entry in block 30.5 will.

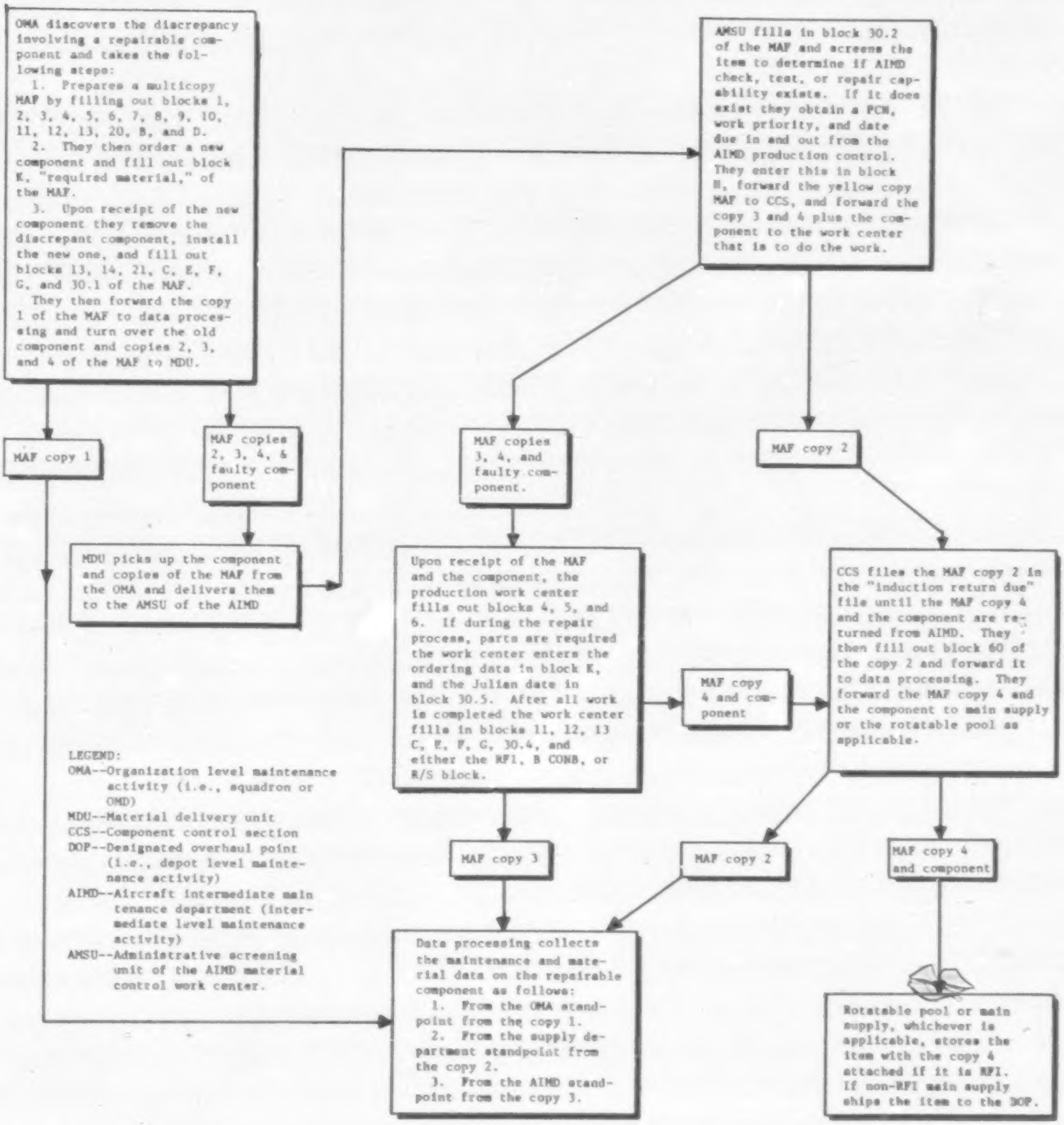
ENTRIES MADE WHEN THE ITEM COMES OUT OF AWP STATUS.–In addition to the date and time received column of data block K, a Julian date entry is made in data block 30.6 when the last item outstanding in data block K is received.

ENTRIES MADE WHEN ALL AIMD ACTION ON THE COMPONENT IS COMPLETED.–After the item has been repaired or determined to be BCM (beyond the capability of the AIMD), data blocks 11, 12, 13, C, E, and F are filled in. In addition, a Julian date entry denoting the date action was completed is inserted in data block 30.4 and either RFI, B COND, or R/S block is marked showing the status of the item. These last two entries carbon through to copy 4.

DISTRIBUTION.–The green copy (#3) is then forwarded to data processing for collection of maintenance and material data from the AIMD standpoint. The copy 4 (hard copy) accompanies the component back to supply.

No original entries are made on copy 4, (fig. 9-20(D)) unless directed locally. All standard entries that appear are the result of entries made on the other three copies and being carboned through. This copy stays with the component and is received with the RFI part when issued from supply.

Figure 9-21 shows the flow of the copies of the Multicopy MAF.



OMA discovers the discrepancy involving a repairable component and takes the following steps:

1. Prepares a multicopy MAF by filling out blocks 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 20, B, and D.
2. They then order a new component and fill out block K, "required material," of the MAF.
3. Upon receipt of the new component they remove the discrepant component, install the new one, and fill out blocks 13, 14, 21, C, E, F, G, and 30.1 of the MAF.

They then forward the copy 1 of the MAF to data processing and turn over the old component and copies 2, 3, and 4 of the MAF to MDU.

MDU picks up the component and copies of the MAF from the OMA and delivers them to the AMSU of the AIMD

AMSU fills in block 30.2 of the MAF and screens the item to determine if AIMD check, test, or repair capability exists. If it does exist they obtain a PCN, work priority, and date due in and out from the AIMD production control. They enter this in block H, forward the yellow copy MAF to CCS, and forward the copy 3 and 4 plus the component to the work center that is to do the work.

Upon receipt of the MAF and the component, the production work center fills out blocks 4, 5, and 6. If during the repair process, parts are required the work center enters the ordering data in block K, and the Julian date in block 30.5. After all work is completed the work center fills in blocks 11, 12, 13 C, E, F, G, 30.4, and either the RFI, B CONB, or R/S block.

CCS files the MAF copy 2 in the "induction return due" file until the MAF copy 4 and the component are returned from AIMD. They then fill out block 60 of the copy 2 and forward it to data processing. They forward the MAF copy 4 and the component to main supply or the rotatable pool as applicable.

LEGEND:
OMA--Organization level maintenance activity (i.e., squadron or OMD)
MDU--Material delivery unit
CCS--Component control section
DOP--Designated overhaul point (i.e., depot level maintenance activity)
AIMD--Aircraft intermediate maintenance department (intermediate level maintenance activity)
AMSU--Administrative screening unit of the AIMD material control work center.

Data processing collects the maintenance and material data on the repairable component as follows:

1. From the OMA standpoint from the copy 1.
2. From the supply department standpoint from the copy 2.
3. From the AIMD standpoint from the copy 3.

Rotatable pool or main supply, whichever is applicable, stores the item with the copy 4 attached if it is RFI. If non-RFI main supply ships the item to the DOP.

AK.450

Figure 9-21.—Multicopy MAF flow.

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